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Evropski sklad za regionalni razvoj

NADZOR NAD NESLEDNJO GENERACIJO NANOTEHNOLOGIJE

Projekt nastajanja nanotehnologije

Prirejen prevod, povzetek in obdelava proizvajalcev in strukture

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Kazalo

1. PREDGOVOR

S tem povzetkom in prirejenim prevodom sem hotel povzeti vse tisto gradivo, ki se mi je zdelo potrebno za razumevanje najnovejših spoznanj na področju nanotehnologije,ki so nastala v prvem desetletju 21.stoletja. Še posebej je ta povzetek zanimiv zaradi dejstva,ker je nastal z namenom seznanitve z vso kompleksnostjo razvoja nanotehnologije in morebitnih posledic s stališča varovanja okolja. Zaradi tega je tudi samo predstavitev sicer zahtevne vsebine prikazana dovolj poenostavljeno za lažje razumevanje. Prav tako sta jedrnato prikazana oba velika problema nanotehnologij: **kompleksnost znanstvenega področja in prav tako zahteven pristop k nadzoru nad temi tehnologijami.** Nujno je namreč razumeti, da nanotehnologije sprožajo številna vprašanja in dvome.Za potencialne izdelovalce pa je to dobra in potrebna informacija o varnostnih predpisih in izjavah,ki jih bo potrebno zagotoviti. Tistega bralca,ki bi ga zanimala le tehnična vsebina bi le opozoril,da si prebere par stavkov o vključenosti javnosti **(7.9)** v ta dogajanja, ker se mi zdi to področje sila pomembno pri razvoju novih tehnologij,še slasti nanotehnologije. Za hiter vpogled je dovolj prebrati poglavja **4,5 in 6.** Tisti,ki pa jih bo zanimalo pokukati v svet proizvajalcev na tem področju bodo dobili del odgovora na poglavju DODATKI,poglavje **9**. Večja vrednost tega prispevka je tudi navedba in povezava na spletne strani posameznih proizvajalcev. Glavnina gradiva pripada avtorju J.Clarence "Terry" Daviesu, ki je velik zagovornik agencije za nadzor nove generacije nanotehnologije in dober poznavalec varovanja okolja. Zato je nekaj več besed posvečeno tudi njemu. Poleg njega so tako v tekstu kot v literaturi omenjeni skoraj vsi najbolj pomembni znanstveniki iz tega področja. Del te literature je na razpolago tudi v digitalnem zapisu. V skoraj 40 letih dela na tem področju, se je svet veliko naučil o okoljskih problemih in kako ravnati z njimi, ter spremenil ravnanje na tem področju z veliko več ukrepov za čistejše okolje, kot je to bilo leta 1970. Toda, kot je opisano v poročilu Terria, so izzivi 21. stoletja zastrašujoči in zahtevajo nove pristope k nadzoru. Potrebujemo bolj uspešen in učinkovit nadzor nad sistemom, tako nad tistim, ki se lahko ukvarja z nanotehnologijo in drugimi znanstvenimi napredki, kot tudi nad množico obstoječih težav.

V tem poročilu, Terry prinaša nekaj širših in inovativnih predlogov o tem, kako naj bi tak nadzorni sistem bil zgrajen. Opisuje nov oddelek za ekologijo in varstvo potrošnikov, ki naj bi bil bolj znanstvena agencija v primerjavi s sedanjo,ki je bolj zakonodajna in takšna, ki bi vključevala bolj celostne pristope za nadzor in spremljanje. Predlaga razpravo za nov zakon, ki bi se osredotočil na reguliranje izdelkov in nova orodja, ki bi se lahko uporabila za reševanje prihodnjih zdravstvenih in okoljskih problemov.

Ti predlogi so pomemben prispevek k dialogu, ki je potreben za oblikovanje boljšega sistema nadzora. Kot Terry pravi, so njegovi predlogi namenjeni bolj za začetek razprave, kot pa za njihov sprejem.

Kljub številnim pomislekom, je večinsko mnenje strokovnjakov, da smo dovolj modri in ne verjamemo v nujnost da bi nas tehnologija obvladala. Dovolj smo pametni, da izkoristimo rezultate tehnološkega napredka in da se zmanjša ali odpravi tveganje za ljudi in okolje. Vendar pa se moramo učiti iz preteklih napak in biti sposobni predvideti prihodnje izzive. Poročilo Terria uporablja izkušnje iz preteklosti pri predlogih političnih usmeritev prihodnosti. Strinjamo se lahko z njim v upanju, da bo poročilo spodbuda mišljenju in dialogu, potrebnima za reševanje težav, ki so

pred nami,zaradi premalo poznavanja in izkušenj,ki jih pred nas postavlja pot v še ne povsem odkrita področja.

2. O AVTORJU

J. Clarence "Terry" Davies, višji svetovalec za projekt o nastajajočih nanotehnologijah (PEN Project on Emerging Nanotechnologies) in višji sodelavec na projektu Viri za prihodnost, je eden od največjih avtoritet predvsem za okoljske raziskave in politiko. Pomagal je pri pionirskih povezavah področji ocenjevanja tveganja, upravljanja tveganja in poročanja o tveganjih , prav tako je njegovo delo povečalo naše razumevanje onesnaževanja prek različnih medijev – nastala je težnja onesnaževanje premakniti prek več meja, od zraka prek vode do zemljišč, ki razkrivajo pomanjkljivosti v pravnem in krmilnem okvirju. Je avtor tudi treh prejšnjih poročil o nanotehnologiji v okviru projekta nastajajočih nanotehnologij.

Davies je bil član prve Busheve administracije, kot namestnik direktorja za politiko, načrtovanje in vrednotenje v agenciji za zaščito okolja v ZDA (Environmental Protection Agency -EPA). Pred tem je bil prvi preglednik za okoljske programe v okviru državnega proračuna (zdaj Urad za upravljanje in proračun). Leta 1970 je bil kot svetovalec predsednika svetovalnega sveta za izvajalske organizacije, soavtor načrta, ki so oblikovale EPA. Dr Davies je bil izvršni podpredsednik **fundacije ohranjevanja**, neprofitnega možganskega trusta za okoljsko politiko, izvršni direktor nacionalne komisije za okolje in višji uslužbenec v svetu za kakovost okolja, v katerem je med drugimi dejavnostmi, napisal izvirno različico tistega, kar je kasneje postal Zakon o nadzoru strupenih snovi. On je bil član številnih odborov nacionalnega raziskovalnega sveta, predsedoval je Svetu odbora za odločanje pri urejanju področja uravnavanja kemikalij v okolju, predsedoval je v EPA svetovalnemu odboru za strupene snovi in bil član znanstvenega svetovalnega odbora EPA. Leta 2000 je bil izvoljen za člana ameriškega združenja za napredek znanosti, na osnovi njegovih prispevkov za uporabo znanosti in analize na področju okoljske politike.

Davies je avtor *The Politics of Pollution, Neighborhood Skupine in Urban Renewal, Pollution Control v ZDA* in več drugih knjig in monografij, ki obravnavajo politiko okoljskih vprašanj. Politolog po izobrazbi, Davies je pridobil B.A. v ameriški vladi od Dartmouth College in doktoriral prav tako v ameriški vladi na Columbia University. Poučeval je na univerzi Princeton in Bowdoin College in je pomagal kot mentor generaciji raziskovalcev okoljske politike.

3. POVZETEK

Od leta 1980 naprej se je sposobnost zveznih agencij, odgovornih za okoljske varnosti in zdravje postopoma zmanjševala. Agencije sedaj ne morejo opravljati njihovih osnovnih funkcij in se ne morejo v celoti spopasti z novimi izzivi, s katerimi se srečujejo v 21. stoletju. Ta dokument opisuje nekatere od teh izzivov, s poudarkom na naslednji generaciji nanotehnologije, in predlaga spremembe, ki bi revitalizirale zdravstvene in varnostne agencije.

Celotno vsebino ni pripisati samemu avtorju, saj je hotel prispevek deliti tudi z ostalimi, ki so prispevali globlja poznavanja snovi,vendar so jo le-ti prostovoljno prepustili njemu in jim je nadvse hvaležen. Še posebej zato, da se vse skupaj ne bi zdelo ali da bi bilo videti, kot da bi en sam vedel več kot v resnici ve o nano znanosti.

Nadzor novih tehnologij v tem stoletju se bo zgodil v povezavi z značilnostmi hitrega znanstvenega napredka, pospešene uporabe znanosti in pogoste spremembe proizvodov. Izdelki bodo tehnično zapleteni, sprožali možne zdravstvene in okoljske probleme in imeli vpliv na mnoga družbena področja hkrati. Prav tako lahko povečajo izzive za moralna in etična prepričanja. Nanotehnologija pooseblja vse te lastnosti, kot tudi zlasti tiste, ki so izziv za konvencionalne metode ocenjevanja tveganja, določanja standardov in izvajanje nadzora.

Zvezne agencije trpijo zaradi premalo sredstev in birokratske okostenelosti, vendar pa bo potrebno več kot le povečano financiranje in manjše spremembe pravil za ustrezno obravnavo možnih škodljivih učinkov novih tehnologij. Novo mišljenje, novi zakoni in nove organizacijske oblike so potrebne. Mnoge od teh sprememb bodo zahtevale desetletje ali več za izvršitev, vendar je nujno treba začeti razmišljati o njih sedaj.

Da bi spodbudila razpravo, ta knjiga opisuje novi zvezni oddelek (zvezno agencijo) za ekologijo in varstvo potrošnikov. Nova agencija, ki naj bi bila sestavljena večinoma iz obstoječih agencij, bi imela tri glavne sestavine: nadzor, raziskave in ocene ter spremljanje. Bila bi bolj znanstvena agencija z močnim poudarkom na nadzoru, v nasprotju s sedanjimi agencijami za uravnavanje-regulacijo, ki so predvsem nadzorna telesa.

Predlagana agencija bi spodbujala bolj celostne pristope, in to bi zahtevalo tudi novo zakonodajo. Enoten pristop k ureditvi izdelkov je potreben za reševanje veljavnih programov, kot so različne spremljave lastnosti in uporabnosti in novih izzivov, kot so nanotehnologije. Bolj celovit pristop k nadzorovanju onesnaževanja je bil potreben še preden je Agencija za zaščito okolja (EPA) bila ustanovljena leta 1970 in od takrat se je ta potreba samo še večala. Celovit sistem dovoljevanja, ki to omogoča, kot je prisoten v Evropski uniji (EU), je ena od možnih poti za nadaljevanje. Pristopi, ki so zasnovani na ekonomskem interesu, bi tudi pomagali poenostaviti nadzor nad onesnaževanjem. Bistvene funkcije za spremljanje okolja in analizo rezultatov so široko razpršeni po vsej vladi in jih je treba združiti. Oblika predlagane nove agencije vključuje predloge za Znanstveno agencijo svetovnih sistemov in urad za okoljsko statistiko. Nova agencija bi morali biti sposobna narediti presojo tehnologije, predvidevanja in spremljanje zdravja in varnosti.

Organizacijske, zakonodajne in druge spremembe, opisane v knjigi naj bi bile izhodišče za razpravo in ne določen nabor sklepov. Prav tako niso namenjeni temu, da bi nadomestili ali zmanjšali potrebo po takojšnji reformi, na primer, za posodobitev akta nadzora strupenih snovi (TSCA). Vendar pa dialog o novih pristopih se mora začeti zdaj. Predlogi iz poročila naj bi pomagali padati okvir za razpravo in ji dajejo poudarek.

Prispevek opisuje nekaj razvojev, ki bodo določili prihodnje tehnologije in nekatere spremembe, ki bi omogočile, da se zvezne vlade spopadejo z novima znanostjo in tehnologijo 21. stoletja. Nadzorni sistem je zdaj pokvarjen. Revolucionarne tehnologije, kot so nanotehnologije in sintetična

biologija se tržijo zdaj. Predlagani sistem nadzora, je le izhodišče za razmišljanje o spremembah, vodar pa so te spremembe nujno potrebne.

4. UVOD

Prvič v človeški zgodovini smo zelo blizu sposobnosti obdelovati osnovne oblike vseh stvari v naravi, **živih in neživih,** dajati jih narazen in jih ponovno sestavljati skupaj na skoraj vsak način, ki si ga lahko privošči domišljija. Zaradi popolnosti (sofisticiranosti), s katero se znanstveniki učijo obdelovati materijo na nano metričnem nivoju nas postavljajo v premoč obvladovanja velikega dela našega okolja. Svet prihodnosti bo opredeljen po tem, kako bomo uporabili to premoč.

V nasprotju z daljnosežnimi in dramatičnimi možnosti novih tehnologij, vladne agencije, odgovorne za zaščito prebivalstva pred škodljivimi vplivi teh tehnologij se zdijo obrabljene in raztrgane. Po skoraj 30 letih sistematičnega zanemarjanja, sposobnosti zveznih zdravstvenih in varnostnih agencij za regulacijo se gibljejo od zelo šibkih do neuporabnih. Poudarek regulativne reforme v tem obdobju je bil v glavnem na tem, kako pridobiti okrog obstoječe regulativne strukture, ne pa na tem, kako jo izboljšati. Regulativni sistem je bil zasnovan za reševanje tehnologij industrijske dobe. Obstaja velika vrzel med zmogljivostmi sedanjega regulativnega sistema in značilnostmi tega, kar nekateri imenujejo naslednja (druga) industrijska revolucija, in ta vrzel se zdi večja skladno z razvojem tehnologij.

Nanotehnologija vključuje delo na ravni posameznih atomov in molekul. Vlada ZDA nanotehnologije opredeljuje kot "pot odkritij, ki so na nano-razdaljah dana na delo oz. v uporabo« (www.nano.gov; accessed 9/19/08). Nano-razdalja je približno 1-100 nanometrov. Za primerjavo, papir, na katerem je natisnjen ta članek, je debelejši od 100.000 nanometrov To pomeni da je 25,4 milijona nanometrov na palec in 10 milijonov nanometrov v centimetru.

Nanometrični materiali se pogosto obnašajo drugače kot materiali z večjimi strukturami, tudi če je osnovni material (na primer, srebro ali ogljika) enak. Nanomateriali imajo lahko različne kemične, fizikalne, električne in biološke značilnosti. Na primer, kos aluminija je povsem varen, vendar aluminij v nano velikost je zelo eksploziven in se lahko uporabljajo za izdelavo bomb.

Nove značilnosti nanomaterialov lahko pomeni, gledano s strani ocene tveganja, da so razviti za navadne materiale in lahko imajo omejeno uporabo pri določanju zdravstvenih in okoljskih tveganj proizvodov nanotehnologije. Čeprav ni dokumentiranih primerov, kjer je mogoče pripisati škodo, posebej za nanomateriale, čedalje več dokazov kaže na potencial za nenavadno zdravje in okoljska tveganja (Oberdorster 2007; Maynard 2006). To ni presenetljivo. Nanometer veliki delci lahko preidejo do slehernega mesta v okolju in človeškem telesu, ki so nedostopni za večje delce, in kot posledica, se lahko pojavijo nenavadne in nepričakovane izpostavljenosti. Nanomateriali imajo veliko večje razmerje površine napram masi kot pri običajnih materialih. Zlasti na površini materialov, kjer potekajo biološke in kemijske reakcije, bi zato pričakovali bolj prisotno odzivnost (reaktivnost) nanomaterialov kot pri sipkih materialih. Nove poti izpostavljenosti in večjo odzivnost lahko predstavljajo koristne lastnosti, vendar pa hkrati tudi pomenijo večji potencial tveganja za zdravje in okolje.

Nadzor je zato sestavljen iz pridobivanja informacij o tveganju in delovanja na njem, da se prepreči zdravstvene in okoljske škode. Temeljna predpostavka tega dokumenta je, da ustreznega nadzora nad nanotehnologije ni potrebno samo za preprečitev škode, ampak tudi za spodbujanje razvoja tehnologije. Združene države Amerike in Evropa, sta se že naučili, da so nadzor in ureditve (regulative) potrebne za pravilno delovanje trgov ter za javno odobravanje novih tehnologij.

Uporaba sedanjih sistemov nadzora nad sedanjimi oblikami nanotehnologij je bila analizirana tako v ZDA kot v Evropi (glej, na primer, Davise 2006; Davise 2007; in Royal Academy for engineering 2004 (Akademija združenega kraljestva za inženirstvo 2004). Pregled obstoječih sistemov v Združenih državah je pokazal, da so v veliki meri neustrezni za reševanje trenutnih nanotehnologij. (Davies 2006, 2007, 2008, 2006 Taylor, 2008; Felcher 2008; Breggin in Pendergrass 2007; Schultz in Barclay 2009). Ta dokument se osredotoča na prihodnje generacije

nanotehnologije. Ni presenetljivo, če sam pregled ugotavlja, da bodo ti pregledi nad izzivi večji, kot nad obstoječo tehnologijo samo. In nič manj kot povsem nov sistem bo potreben ali bo zadostoval za obravnavo naslednje generacije nanotehnologije.

Pisno sporočilo začenja s preiskavo o prihodnosti nanotehnologije. Nato analizira zmogljivosti obstoječih politik nadzora in oblasti za soočanje s pričakovanim tehnološkim razvojem. Sklepanje, da so obstoječi sistemi neustrezni, je vzrok da je večji del dokumenta namenjen razmišljanju o bolj ustreznem sistemu nadzora za nove tehnologije na splošno in zlasti še za nanotehnologijo. Če pri razmišljanju o novih oblikah nadzora zgrešimo in ohranimo status quo na dolgi rok in pri tem kličemo in prisegamo samo na negativne učinke, tvegamo da ogrozimo tudi priložnosti novih tehnologij stoletja.

5. PRIHODNOST NANOTEHNOLOGIJE

Napovedovanje prihodnosti katerekoli od večjih tehnologije je težko. Na eni strani obstaja zelo pogosto težnja, ki podcenjuje vpliv tehnologije in hitrost razvoja. Razvoj nanotehnologije pa je že prehitel napovedi, ko jih je podala NNI (National Nanotechnology Initiative) ob priliki njene ustanovitve leta 2000. V tistem času je bil poudarek na vplivu ki bi ga lahko imela nanotehnologija v letih 2020-2030 (Roco 2007). Zdaj, analiza podjetja Lux Research napoveduje, da bo do leta2015 **nano vključen v $ 3100 miliard končnih izdelkov po vsem svetu** (Lux Research 2008) in bo **omogočal za 11 odstotkov proizvodnih delovnih mest po vsem svetu** (Lux Research 2006).

Lahko pa da sta potencial tehnologije in hitrost njenega razvoja pretiravanje. Obstaja veliko primerov tehnološkega napredka, za katere je bila napoved skorajšnje uresničitve,a je do realnega napredka prišlo šele po desetletjih ali celo stoletjih. Nadaljnja težava leži v možnosti, da se tehnologija lahko razvije v povsem nepričakovane smeri in se uporablja tako, kot ni nihče predvidel.

To poglavje se začne s pregledom več analiz nanotehnologije v prihodnosti in sedanjega stanja nanotehnologije. Nato je pregled aplikacij raziskav, ki se bodo verjetno pojavile v naslednjih 10-20 letih. V sklepnem delu se z destilacijo lastnosti ugotavlja verjetne značilnosti tehnologij prihodnosti na splošno in naslednje generacije nanotehnologije posebej.

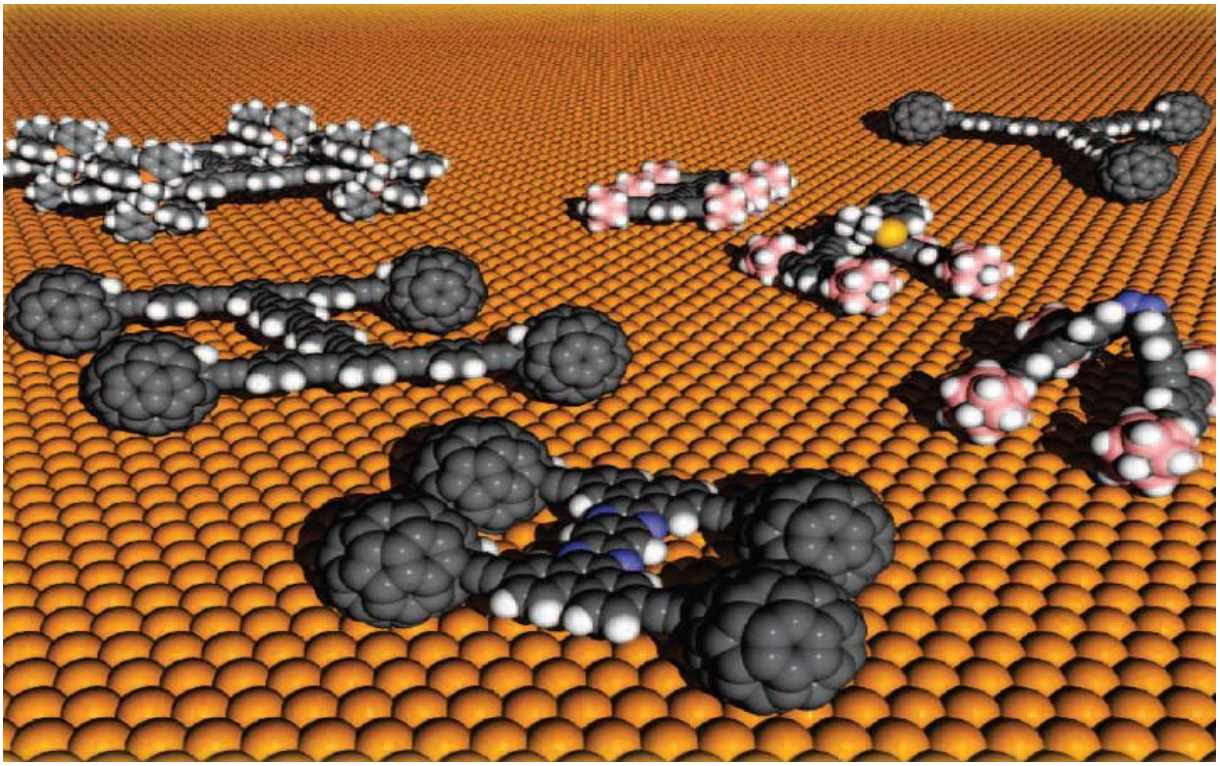
5.1 Razvoj in raziskave nanotehnologij

Glavnino teže analize prihodnje nanotehnologije so poskušali kategorizirati prek vrste raziskav, ki se izvajajo in / ali vrste uporabe tehnologije. Najbolj preprosto uvrščanje (kategorizacijo) uporablja James Tour (2007) na podlagi dela v svojem laboratoriju na Rice University. On razvršča nanotehnologije, kot pasivne, aktivne ali hibridne (tj., tehnologije, ki so vmesni člen med aktivno in pasivno). Tour prav tako podaja oceno **potrebnega časa za trženje ali komercializacijo posamezne vrste** in pr tem navaja od **0-5 let za pasivne nanotehnologije, 15-50 let ali več za aktivne nanotehnologije in 7-12 let za hibride**.

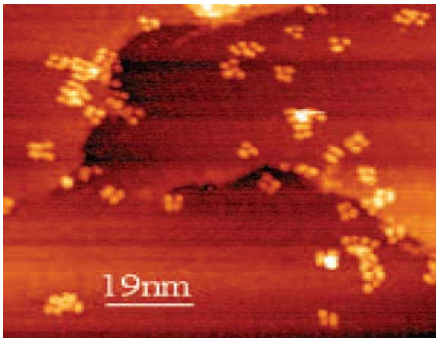
Glede na Tourove razvrstitve, skoraj vse sedanje uporabe nanotehnologij sodijo v pasivne,večina pa se nanaša na dodajanje nanomaterialov k navadnim, kot način za izboljšanje učinkovitosti le-teh. Na primer, on ugotavlja, da dodajanje ogljikovih nanocevk na navadno gumo lahko močno poveča žilavost gume brez zmanjšanja njene prožnosti. Uporabnost pasivne nanotehnologije vključuje uporabo nano materialov kot so: ogljikove nanocevke, srebrni nanodelci in porozni nanomateriali - materiali, ki vsebujejo luknje, velikosti nekaj nanometrov v premeru. Te aplikacije uporabljajo nanomateriale za dodajanje opravilnosti (funkcionalnosti) izdelkom, ki izhajajo iz njihove kemične in fizikalne oblike, bolj kakor pa od tega kako se odzivajo na njihovo okolje.

Tour opredeljuje neko aktivno nanotehnologijo, kot tisto, kjer "nano primerek (entiteta) izvaja nekatere podrobnosti." Tako daje primer "nanoavta," edinstveno nano-izvedena molekula, ki se lahko uporabljajo za fizični premik atomov iz enega mesta na drugo (glej sliko o "Beyond Synthetic Chemistry)". Eden najpomembnejših ciljev naslednje generacije nanotehnologije je posnemati naravo z oblikovanjem sistemov in naprav na tak način, da se stvari gradi od spodaj navzgor, (to je, izdelava stvari z gradnjo atom za atomom in molekula za molekulo).

Na oni strani umetne kemije (beyond synthetic chemistry) : Primer naslednje generacije nanotehnologije



Računalniško generirana slika molekularnega «nanoavta«



Mikroskopski posnetek skeniranja molekul »nanoavta« v tunelu. Štiri molekule ogljika 60, ki tvorijo kolesje vsakega «nanoavta« so dobro vidne.

Mnogi znanstveniki so si enotni v tem, da smo do sedaj samo postrgali površino od celega obsega molekul,ki jih je mogoče narediti. Napredovanje bo možno samo če bomo imeli boljša orodja in bolj celovito razumevanje kako stvari delujejo na nano obsegu. Nadgradnja nad dosežki v znanosti in inženiringu, bo naslednji generaciji nanotehnologij omogočilo načrtovanje in konstrukcijo naraščajoče komplekse molekul,ki se bodo kosale z onimi, ki jih najdemo v biologiji,zlasti pri izrazu njihovih rafiniranosti.Za primer vzemimo dr.Jamesa Toura in njegove raziskovalne skupine na Rice University,ki je ustvarila na inovativen način nov razred molekul imenovan »nanoavti«.Leti se lahko premikajo čez površino in so zmožni prenašati materiale z ene točke do druge vse na nano obsegu.[1,2] Znanstveniki odkrivajo da so številni biološki procesi odvisni od milijard molekul,ki izvajajo fizične naloge,vključno s prenašanjem materialov pri gradnji,popravilu in celicah življenjske energije. S posnemanjem teh procesov v naravi in ob uporabi umetnih molekul-kot so »nanoavti« morda odpiramo vrata izgradnji zelo zapletenih novih materialov in izdelkov,ki jih je mogoče uporabiti v medicini,elektronskih napravah in gradbenih materialih.

1. Sasaki, T., Osgood, A.J., Alemany, L.B., Kelly, K.F., and Tour, J.M. 2008. Synthesis of a Nanocar with an Angled Chassis. Toward Circling Movement. Organic Letters. 10(2), 229-232.

2. Vives, G. and J. M. Tour (2009). “Synthesis of Single-Molecule Nanocars.” *Acc. Chem. Res.* **42**(3): 473-487.

*Image courtesy of the American Chemical Society

**Image courtesy of the James M. Tour Group. http://www.jmtour.com/?page_id=33

To pomeni,da začenši samo z posameznimi molekulami bi nekdo lahko naredil računalniški čip,zelo močne materiale,biološka tkiva ali skoraj karkoli drugo. Osnovne metode po katerih bi bilo to mogoče storiti so samo-montaže ali samo sestavljanje, molekularna gradnja ali kombinacija obeh. Novejše nanonaprave kakršen je nanoavto bi bilo možno vzeti kot osnovo za molekularno gradnjo. Praktične aplikacije gradnje od spodaj navzgor so odprte za sleherno domišljijo, vendar lahko vključuje popravilo človeškega tkiva ali proizvodnjo energije z fotosintezo.

M.C. Roco, ena od gonilnih sil NNI, je razvil podrobnejšo tipologijo nanotehnologij (Roco 2004, Roco 2007). On ugotavlja štiri generacije nanotehnologije: pasivne nanostrukture, aktivne nanostrukture, sistemi nanosistemov in molekularni nanosistemi.

Skoraj vse trenutne aplikacije in uporabe nanotehnologije pripadajo prvi generaciji po Rocu, kategoriji, ki je v osnovi enak kot pasivna kategorija po Touru. Uporabo v tej kategoriji najpogosteje zaznamujejo združevanje nanomateriala z nekim drugem materialom za dodajanje funkcij ali vrednosti pri čemer se vedenje nanomateriala časovno bistveno ne spreminja.

Druga generacija po Rocu, aktivna nanostruktura, praviloma vključuje strukture obsega nekaj nanometrov, da spremenijo vedenje kot odgovor na spremembe v njihovem okolju. Te spremembe lahko povzročijo mehanske sile, magnetno polje, izpostavljenost svetlobi, prisotnost nekaterih bioloških molekul ali drugih dejavnikov. Roco predvideva aktivne nanostrukture za združevanje v veliko večji naprave ali sisteme, da bi jih na ta način lahko uporabljali v praksi. Primeri vključujejo nove tranzistorje in druge elektronske komponente, ciljna zdravila in kemikalije, namenjene za posebne naloge - po vzorcu Tourovih nanoavtov .

Tretje in četrte generacije nanotehnologije so bolj abstraktne. V skladu z Rocom (2007, str 28), tretja generacija vključuje "sisteme nanosistemov s tridimenzionalnimi nanosistemi z uporabo različnih sintez in montažnih tehnik, kot so biomontaža ; robotika z novim vedenjem, in razvijajoči se pristopi." Vključuje "usmerjeno večplastno samosestavljanje ... umetna tkiva ... in obdelavo podatkov z uporabo fotonov."). Četrta generacija "bo prinesla heterogene molekularne nanosisteme kjer vsaka molekula v nanosistemu ima posebno strukturo in igra drugačno vlogo« *(Ibid.*, st. 29). Vključevala bo makromolekule ", glede na obliko," nanometrične stroje in vmesnik med ljudmi in stroji na ravni tkiva in živčnega sistema.

Celo zelo dobro obveščeni strokovnjaki so izrazili težavnost razlikovanja med zadnjimi tremi Rocovimi generacijami in pri razumevanju nekaterih aplikacij, ki jih opisuje. Vendar pa je najmanj kar kažejo na prihodnji razvoj in uporabo nanotehnologije, ki so vedno bolj dodelane, ki vodijo do materialov in izdelkov, ki se obnašajo na različne načine (tudi nepričakovane) skladno s smermi ali namembnostjo uporabe. Ti materiali in izdelki bodo zelo drugačni od tistih, ki so danes prisotni in bodo imeli vpliv na širok spekter sektorjev in uporabnikov.

Tretjo tipologijo je razvila Vrishali Subramanian, ki je vodila obsežna bibliografska iskanja raziskav na področju aktivnih nanostruktur za Woodrow Wilson International Centre in jih uporabila za šolski projekt nastajajočih nanotehnologij (PEN) (neobjavljeni raziskovalni papir).

Njena analiza priporoča, da iz obsežne raziskave literature izhajajo naslednje kategorije aktivnih nanostruktur :

(1) **daljinsko aktivirana - nanotehnologija**, katere aktivno delovanje se daljinsko aktivira;

(2) **okoljsko odzivna - nanotehnologija**, ki je občutljiva na dražljaje, kot so pH, temperatura, svetloba ali nekatere kemikalije;

3) **miniaturinizirana - nanotehnologija**, ki je konceptualno zmanjševanje večjih naprav in tehnologij;

(4) **hibridna nanotehnologija**, ki vključuje občasne kombinacije (organsko-anorganskih) materialov,

in (5) **preoblikovalna - nanotehnologija**, pri kateri se zgodijo nepovratne spremembe v določeni fazi njene uporabe ali življenja. Prav tako ugotavlja, da aktivni nanostrukturni prototipi ni nujno da sodijo v samo eno od teh kategorij in da je v resnici, če inovacija sodi v več kot eno kategorijo, verjetno bolj zapletena in dinamična.

Skoraj vsi opazovalci napovedujejo, da pomemben vidik prihodnje nanotehnologije pomeni njeno združitev z drugimi tehnologijami in kasnejšega pojava zapletenih in inovativnih hibridnih tehnologij. Na biologiji zasnovane tehnologije se že prepletajo z nanotehnologijo. Nanotehnologijo se že uporablja za spreminjanje genskega materiala, in nanomateriali se že gradijo z uporabo bioloških komponent.

Neločljivo povezana zmožnost nanotehnologije pri obdelavi snovi na najmanjši ravni je nepričakovano odpiranje novih vrat na področjih, kot so biotehnologija, informacijske tehnologije in kognitivne znanosti, in vodi k novim in preoblikovanim povezavam med temi in drugimi področji. Nekateri strokovnjaki, kot so Mike Roco in Bill Bainbridge (2003), napovedujejo, da bo približevanje nanotehnologije, biotehnologije ter informacijske in kognitivne znanosti določalo značilnosti 21. stoletja. Drugi so šli še veliko dlje, kar kaže, da je nanotehnologija ena od tiste zbirke tehnologij, ki bo povlekla pri preoblikovanju tehnološkega napredka obdobje v življenju brez primerjave v dosedanji zgodovini - tako imenovanega stika s tehnološko posebnostjo, ki ga je popularizira Ray Kurzweil (2006). Čeprav so te ideje lahko zdijo bliže znanstveni fantastiki, kot dejstvo znanosti, se je težko izogniti občutku, da nanotehnologija označuje ločitveno točko med preprostimi na kemiji zasnovanih proizvodov in med izpopolnjenimi izdelki, ki vključujejo kompleksne in prilagodljive strukture na nano velikostih.

5.2 Uporabnosti trenutnih raziskav

Prihodnja nanotehnologija bo vplivala na skoraj vsa področja človeškega delovanja. Medicina, hrana, oblačila, obramba, nacionalna varnost, čiščenje okolja, energija, elektronika, računalništvo in gradbeništvo sodijo v tista področja in sektorje, ki bodo spremenjena z inovacijami nanotehnologije. Tukaj je predstavljeno nekaj primerov raziskav ki bodo verjetno povzročili praktične uporabe v naslednjih 15 letih:

Pametna zdravila - zdravljenje raka. Precej raziskav, ki vključujejo različne nanotehnologije, je bil namenjen za odkrivanje in zdravljenje raka (Zhang 2007). Eden od glavnih ciljev ob uporabi nanotehnologije za medicinske namene, je ustvariti naprave, ki lahko delujejo v notranjosti telesa in služijo kot dostavni sistem zdravil s posebnimi cilji (Pathak in Katiyar 2007). ***Sedanje zdravljenja raka z uporabo sevanja in kemoterapijo pomeni metodo napadanja,kar povzroča izčrpavajoče neželene učinke. Takšna zdravljenja ubijajo tako rakave kakor zdrave celice.*** Nanotehnologija ima potencial za zdravljenje različnih oblik raka z usmerjanjem le na rakave celice. Raziskovalci na univerzi Rice so razvili tehniko z uporabo toplote in nanodelcev za ubijanje rakavih celic. Z zlatom obloženi nanodelci za zbiranje okoli rakavih celic se vbrizgajo v telo. Viri sevanja, podobni radijskim valovom, se nato uporabijo za prenos ozkega razpona elektromagnetne frekvence, ki so uglašeni na povezavo (interakcijo) z nanodelci zlata. Delci so ogrevajo s sevanjem in lahko ubijejo rakave celice, ne da bi prizadeli okoliških ne-rakavih celic (O'Neal 2004).

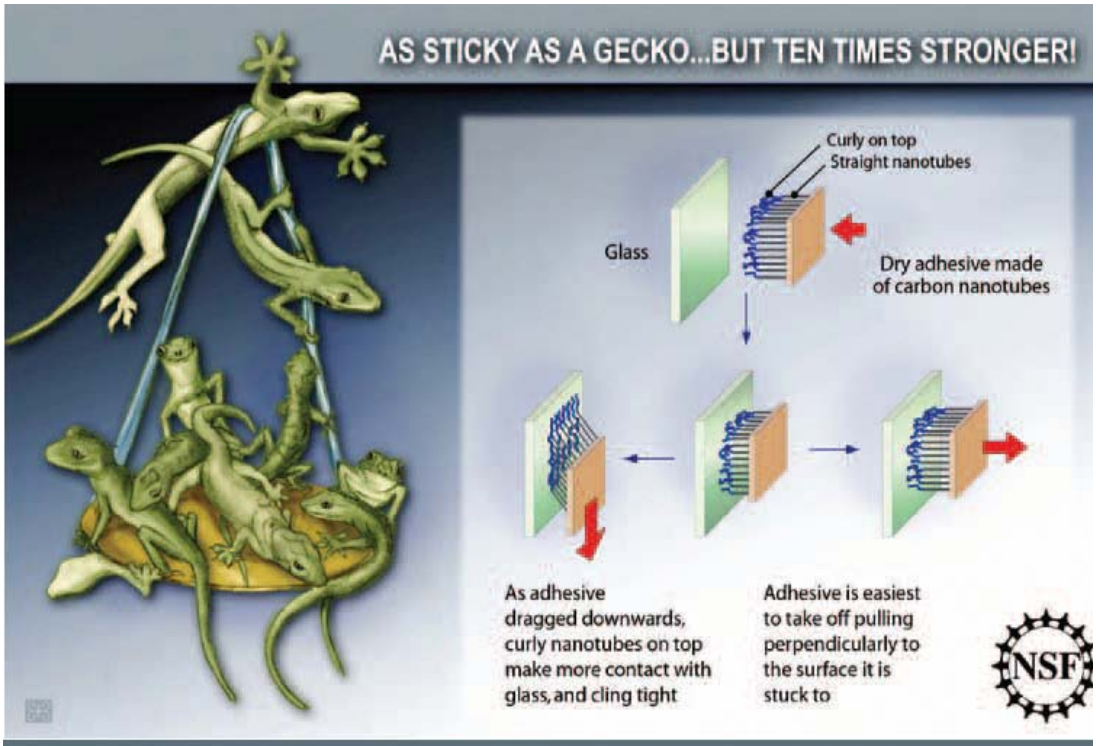
Mauro Ferrari in njegova raziskovalna skupina na Univerzi v Teksasu se je usmerila v zgodnje odkrivanje raka z uporabo lab-on-a-chip tehnologijo z delci, ki lahko izvlečejo in skoncentrirajo proteine,ki nas zanimajo za analize, iz vzorcev krvi. Ista ekipa uporablja vbrizgljive nanomateriale, da delujejo kot nosilci za zdravila in se na ta način izognejo biološkim oviram ter se usmerijo v določene dele telesa (University of Texas 2006).

Vojaške aplikacije. Ameriška vojska in Massachusetts Institute of Technology (MIT), sodelujeta na obsežnem programu za uporabo nanotehnologije pri načrtovanju novih bojnih oblek za vojake. Cilj je oblikovati "proti kroglam odporno obleko, ki ni debelejša od navadne obleke in v največji možni meri spremlja zdravstveno stanje vojaka, lajša poškodbe, samodejno posreduje podatke in takoj reagira na kemične in biološke dejavnike" (http://web.mit.edu/isn /; dostopno 11/7/08).

Naslednja generacija računalniške obdelave. Številni raziskovalci iščejo uporabe nanomaterialov in nanotehnoloških tehnik z namenom znatno izboljšati računalnike. Leta 2007 je raziskovalcem International Business Machines Company (IBM) uspelo uporabiti samosestavljivo nanotehnologijo za izboljšanje trenutnega toka v čipih za 35 odstotkov. S tem novim pristopom, imenovanim tehnologija zračne vrzeli (air-gap technology), se pričakuje, da se bo število tranzistorjev,ki jih lahko spravimo na čip početverilo v primerjavi z današnjim številom. Naravni proces, ki oblikuje školjke, snežinke in prevleko na zobeh, se pri tem uporablja za oblikovanje trilijona lukenj za oblikovanje izolacijskih praznin (vakuuma) okoli tisočerih žic v nanometrskem merilu pakiranih druga ob drugi znotraj vsakega računalniškega čipa.

Programirana biologija - najmanjše baterije. Tehnologija baterij je glavna ovira za različne namene uporabnosti, začenši od električnih avtomobilov do miniaturiziranih medicinskih pripomočkov za vsaditev. Ena od glavnih omejitev sedanjih tehnologija baterij je, da je manj kot polovica prostora / teže baterije zasedena z materiali, ki služijo za dejansko shranjevanje električne energije. Da bi povečali "energijsko gostoto" v bateriji, je znesek neaktivne snovi potrebno zmanjšati. Angela Belcher in njeni sodelavci na MIT so zgradili (sprojektirali) virus,ki se ga uporablja kot "programabilen molekularni gradnik za predlogo rasti anorganske snovi in doseganje samo-montaže." Te izdelane viruse so uporabili za pridelovanje (rast) nanožice kobaltovega oksida, ki delujejo kot anoda za baterije. Kobaltov oksid bi lahko znatno povečal zmogljivost shranjevanja litij-ionskih baterij in se uporabljal tudi za izdelavo mikro baterije (Nam et al. 2008). Na podlagi tega, je skupina Belcherjeve izdelala genetsko spremenjene viruse,ki so se obdali s prvim plaščem iz železove fosfata, ki lahko nato zgrabijo ogljikove nanocevke (delujejo kot katoda) in pri tem nastaja mreža visoko prevodnega materiala (Lee 2009). Z združitvijo dveh komponent (anode in katode) je raziskovalna skupina razvila prototip baterije v velikosti kovanca, ki ima enake energijske zmogljivosti kot baterija, ki se lahko uporabljajo v hibridnem vozilu (Trafton, 2009). Uporabljajoč zmožnost virusa pri samo sestavljanju, skupina Belcherjeve upa, da bodo ustvarili popolnoma samosestavljive visoko zmogljive baterije, ki bi lahko postavili na vlaknine vezij ali drugih materialov (Nam 2008).

Complex materiali - super-lepilo. Znanstveniki in inženirji se pogosto spogledujejo z naravo za reševanje kompleksnih problemov in razvoj tehnologij, ki imajo sposobnost posnemanja narave. Na primer, sposobnosti gekonov (vrsta živali), da se držijo površin in hodijo z lahkoto po stenah je vodilo raziskovalce do izdelave gradiv, ki lahko posnemajo mikroskopske elastične dlačice, ki so na nogah te živali (glej ilustracijo za Complex materiali). Uporabljajoč ogljikove nanocevke, Liangti Qu in kolegi na univerzi v Daytonu (Ohio) so ustvarili snovi, ki so po privlačni moči približno 10-krat močnejši, kot pri gekonovem stopalu.



Advanced nanotechnology is enabling scientists to develop sophisticated new materials that can be used novel ways. For instance, researchers have created a gecko inspired adhesive with ten times the stickiness o gecko s foot, by combining vertically aligned nanotubes with curly spaghetti like nanotubes.

Credit: Zina Deretsky, National Science Foundation after Liangti Qu et al., Science 10/10/2008

Napredna nanotehnologija omogoča znanstvenikom razvijati zelo dovršene materiale .

Ti materiali iz nanocevk imajo veliko močnejše sile oprijema vzporedno s površino v primerjavi z onimi ki so pravokotno na površino. Posledica tega je material, ki se ga lahko uporablja za prijem večje teže na navpično površino ob tem da se ga z lahkoto odstrani. In prav tako kot je gekon zmožen hoditi navzgor po vertikalnih površinah z lahkoto, novi materiali odpirajo možnost oblikovanja oblačil, ki bodo omogočili ljudem doseganje istih spretnosti.

Metamateriali-nadzor pretoka svetlobe. Povsem novo področje znanstvenih raziskav, ki se imenuje preoblikovalna optika, se je odprlo zaradi zmožnosti nanotehnologije pri ustvarjanju novih materialov, ki ukrivlja svetlobo "na skoraj samovoljen način," kar omogoča " izvedbe, ki so predhodno bile obravnavane kot nemogoče "(Shalaev 2008). Te aplikacije vključujejo "elektromagnetni plašč", ki sam ukrivlja svetlobo okrog sebe, s čimer sta tako plašč in znotraj njega objekt skrita. Na ta način se "hyperleče", lahko doda na konvencionalne mikroskope, kar jim omogoča, da se jih uporablja za prikaz nanovelikosti in s tem za prikaz virusov in morebiti DNA molekule *(Ibid.)*

Generiranje energije in uporaba. Nove generacije: senzorjev zasnovanih na nano osnovi, katalizatorjev in materialov, že prinašajo k večjemu zmanjševanju porabe energije in je nadaljnji napredek resničen in realen. Naftna družba ConocoPhillips je pred kratkim podelila tri letno nagrado v višini1.2 million $ Univerzi v Kansasu za raziskave uporabe nanotehnologije za povečanje črpanja nafte (ConocoPhillips sporočilo za javnost, 12/2/08). Nanometrični katalizatorji in nanoporozne membrane so bili, pod določenim okoliščinami, uporabljeni za pospeševanje

proizvodnje bioenergije. Prenos energije bi bilo možno narediti še precej bolj učinkovito z uporabo nanomaterialov. V celotnem sektorju obnovljivih virov energije, ima nanotehnologija potencial za povečanje učinkovitosti procesa in procesa donosov, zmanjšanja stroškov in omogočanje energetskih procesov, ki jih za sedaj ni mogoče doseči na noben drug način. Nanotehnologija omogoča preoblikovanje fotonapetostnih celic s pomočjo razvoja novih in cenejših tehnik izdelave in novih metod za ustvarjanje strukture visoko- površinskih- območij, optimizacijo občutljivosti in povečanje spektralne vpojnosti celic (Saunders 2007). Druge aplikacije v sektorju obnovljivih virov energije vključujejo uporabo nanometričnih površinskih lastnosti in nove nanoproizvodne tehnike za povečanje proizvodnje električne energije v vodikovih gorivnih celicah. Večina tehnologij obnovljivih virov energije je možno narediti bolj učinkovito z uporabo različnih oblik nanotehnologije, za zdaj vsaj na laboratorijskem nivoju. Ali se bo te učinkovitosti prenašalo v gospodarsko učinkovitost bo odvisno od izdelavnih in drugih stroškov (Saunders 2007).

Časovni okviri, znotraj katerih se bodo te novosti tržile bodo različni za različne inovacije in se bodo razlikovale glede na to, kdo podaja to oceno. Na primer, Tour (2007, str 361) ocenjuje, komercializacijo področij za aktivne nanotehnologije v obdobju naslednjih 15-50 let, in ugotavlja, da je "resnično razburljiv razvoj nanotehnologije ... pogosto 30-50 let proč, ali celo 100 let stran." Roco (2007, str 28), v nasprotju s tem napoveduje, da se celo najbolj napredne njegove generacije začele tržiti do leta 2015 ali 2020. . Roco je lahko preveč optimističen in zaradi sedanje svetovne recesije bo verjetno prišlo do zamude komercializacije novih odkritij, ker podjetja in vlagatelji imajo manj denarja in so manj naklonjena tveganjem. Kakorkoli že, pa so pospešeni koraki znanstvenih odkritij, kot tudi komercialne prilagoditve, bile v zadnjem obdobju značilne za razvoj nanotehnologije.

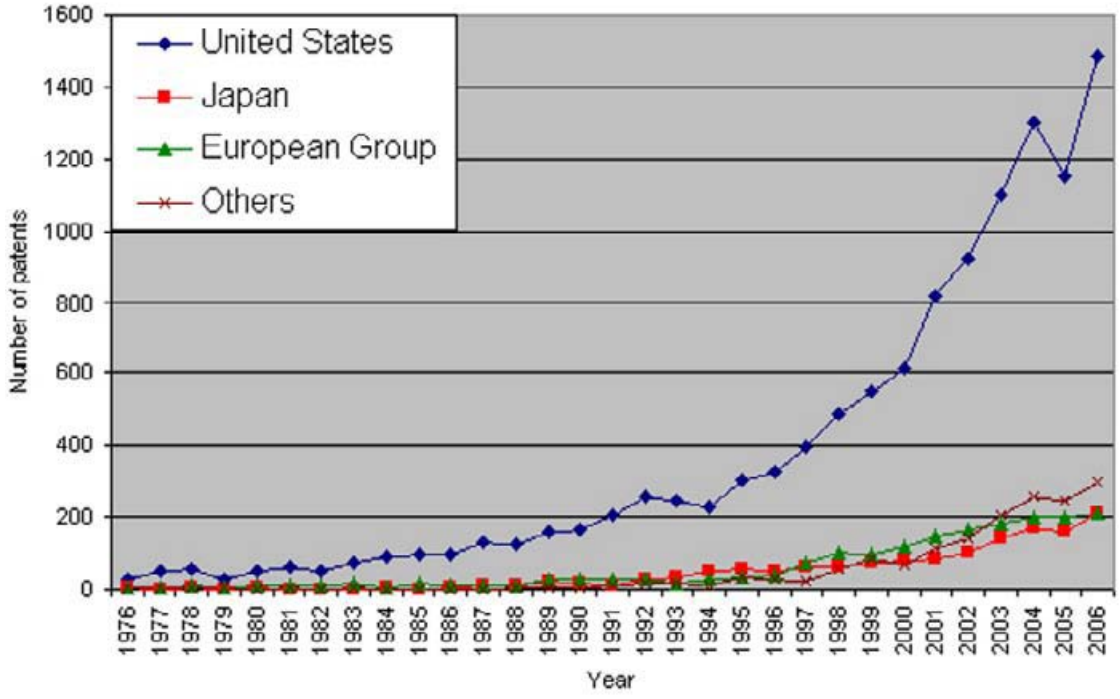
5.3 Značilnosti naslednje generacije nanotehnologij

Z ekstrapolacijo razvoja nanotehnologij in spodbujeni z izkušnjami drugih novih tehnologij, je mogoče določiti številne lastnosti naslednje generacije nanotehnologij. Te razdelimo na splošne lastnosti, ki veljajo za večino novih tehnologij in lastnosti, ki so edinstvene ali še posebej uporabne za nano.

Splošne ali generične značilnosti vključujejo:

Hiter napredek znanosti. Pogosto je bilo ugotovljeno, da večina znanstvenikov, ki so kdaj koli živeli v okviru teh področij, je živih še danes. Ljudje, orodja, viri in institucije, ki trenutno obstajajo v nadaljevanju znanstvenih spoznanj, so po obsegu večji od vsote le-teh v vsem prejšnjem obdobju človeške zgodovine (glej Bowler in Morus 2005). **Posledica tega je, da je razvito več znanstvenega spoznanja in ta razvoj se bo odvijal hitreje, kot kadar koli prej v zgodovini.** Zaradi široke uporabnosti razvitih orodij in konceptov se tempo razvoja nenehno pospešuje. To se kaže v drastičnem dvigu števila patentov v nanotehnologiji (glej sliko. 1).

Hitra uporaba znanosti. Nova spoznanja so danes uveljavljajo v praktični uporabi hitreje kot kadarkoli prej v preteklosti. Razmejitvena črta med znanostjo in tehnologijo je popolnoma zamegljena. Telekomunikacije, zlasti računalnik in internet, omogočajo da se nove tehnologije hitro širijo po vsem svetu. Preboj tradicionalne kulture je odstranil veliko število intelektualnih in kulturnih ovir pri prilagajanju novim tehnologijam.



Povzeto po Chen in Roco 2009.

Pogoste spremembe izdelkov. Posledica hitrega prodora znanosti in tehnološkega razvoja je tudi ta, da se značilnosti izdelkov spreminjajo zelo pogosto (glej Fine 2000;Mazurek 1999).Pogostost s katero se spreminjajo tako izdelki kakor izdelovalni postopki je izziv za katerikoli nadzorni sistem, ker se koraki birokracije in postopkov regulacije niso vidno spremenili;celo več,upočasnili so se pod težo številnih postopkovnih zahtevkov.

Tehnična kompleksnost: Nanotehnologija je kakor večina novih tehnologij kompleksna. Povezuje več disciplin, ki vključujejo fiziko,kemijo in biologijo in številne specialnosti znotraj teh disciplin. Ta kompleksnost uporablja visoko tehnični besednjak,zelo zapleteno matematiko in koncepte, ki imajo kar nekaj sider v vsakodnevnih izkušnjah. Te karakteristike delajo težave celo izobraženim ljudem v razumevanju kaj lahko nova tehnologija naredi. Ta kompleksnost ne samo da ustvarja oviro pri komuniciranju z javnostjo, temveč tudi postavlja zahteve agencijam za nadzor po zaposlitvi novega tipa ekspertov,ekspertov,ki bi jih sicer lahko bilo manj a predragih za najem.

Potencialni problemi zdravja in okolja. Nove tehnologije zelo pogosto imajo nepričakovane ali neželene posledice. Ker pa se je naše znanje tako glede delovanja človeškega kakor okoljskega ekosistema povečalo,smo se tudi več naučili o poteh po katerih lahko ima nova tehnologija vpliv na zdravje in okolje. Uresničevanje tega dejstva,da številne nove tehnologije imajo potencial za takšne vplive,je tudi glavni razlog za uporabo nadzora. Za primer vzemimo spoznanja iz 60-tih in 70-tih let prejšnjega stoletja,ko je bilo prepoznana možnost škodljivih učinkov kemikalij,ki niso bila omejena na posamezne kemikalije in posamezne odklone,temveč je bilo nekaj kar je bilo treba upoštevati za vse kemikalije. Spoznanje je privedlo do odločbe o uvedbi nadzora nad strupenimi snovmi v Združenih državah Amerike in podobne zakonodaje v Evropi.

Širše družbene posledice. Najpomembnejše pri novih tehnologij, kot so nanotehnologije in genski inženiring, je to da presegajo kategorije, ki se običajno uporabljajo za tehnologije. Tako navadno govorimo o medicinskih ali tehnologijah za prenos energije, vendar ko govorimo o nano, na primer, bodo le-te imele velike posledice za vse te in še mnoge druge sektorje. **Nič ne pretiravamo, če rečemo, da bo nanotehnologija spremenila naš način življenja.**

Možni izzivi za moralna in etična prepričanja. Posledice zaradi širokega vpliva novih tehnologij lahko pri posameznih aplikacijah ali implementacijah dvignejo osnovna moralna vprašanja. Če je mogoče uporabiti nanotehnologijo za izboljšanje delovanja človeških možganov, ali jo je treba uporabljati na tak način? In če je tako, za katere možgane? Če so nanometrični materiali vključenih v živilih za izboljšanje prehranskih lastnosti, roka trajanja ali okusa, bi bilo potrebno živila označiti, da je možno razbrati uporabo nanomaterialov? Če sintetična biologija, ki uporabljajo nanotehnike, lahko ustvari nove oblike življenja, bi bilo to dovoljeno storiti? Ko tehnologije dvignejo te vrste vprašanj, mora biti širša javnost pomemben igralec,če že ne mora imeti pomembno vlogo pri razvoju in uporabi tehnologije. Javnost bo igrala vlogo potrošnika, ko pride do trženja tehnologije, vendar družba še ni razvila institucije, ali mehanizmov, ki bi omogočali, da javnost izrazi svoj glas in bi se ga slišal, ko tehnologijo še vedno razvijamo. Javnost v vlogi davčnega zavezanca, najmanj kar mora, je imeti glas, v katere tehnologije se vlaga javna sredstva in se jih podpira. Razni državni zbori ali kongresi očitno izvajajo nekaj nadzora nad tem, vendar le redko smo priča razpravam o posledicah nove tehnologije ali o prednostnih nalogah med tehnologijami. Tehnologija mehanizmov javnega sodelovanja-participacije-zaostaja za znanostjo,ki temelji na tehnologijah 21. stoletja.

Značilnosti nanotehnologije, še posebej naslednje generacije nanotehnologije, kar jo dela še posebej zahtevno, vključujejo:

Spremembe v materialih. Številni nanomateriali v napredni stopnji raziskav so načrtovani tako,da v določenih okoliščinah spreminjano njihove lastnosti. Materiali se lahko spremenijo, kot odgovor na zunanje dražljaje, elektromagnetno sevanje, temperaturo ali spremembe v pH. Sprememba je lahko nepovratna ali samo začasna. Kakršnekoli spremembe v nanomaterialih v daljšem časovnem obdobju in v različnih okoliščinah, zapletejo nadzor, saj se tveganje lahko spremeni s spremembo materialov.

Pomanjkanje metod ocenjevanja tveganja. Tudi že prve generacije nanotehnologije izzivajo tradicionalne metode ocenjevanja tveganja. Večkratne lastnosti prispevajo k strupenosti mnogih nanomaterialov, ki vključijo ne le maso ali število delcev, ampak tudi obliko delcev, električen naboj na površini delcev, prevleko delcev z drugim materialom in številne druge značilnosti. Znanost še mora določiti, katere od teh lastnosti so najbolj pomembne in v kakšnih okoliščinah; določitev tega ne bo enostavna. Obstaja tisoče možnih variant enostenskih ogljikovih nanocevk (Schmidt 2007, str 18), in enostenske ogljikove nanocevke so le ena od več sto vrst nanomaterialov. Naslednja generacija nanomaterialov bo povzročilo še večje težave, odvisno od materialov, funkcij in vrste aplikacij.

Samo-sestavljanje. Številne naslednje generacije nanotehnologije bodo posledično oblikovale materiale, ki se uredijo v kompleksne in uporabne nanometrične strukture z malo ali brez dodatne manipulacije. Izdelane molekule in nanodelci, ko jih medsebojno pomešamo, se naravno oblikujejo v bolj zapletene strukture, kar lahko povzroči energetsko učinkovitejšo proizvodnjo in možnost oblikovanja nanomaterialov, ki se lahko zberejo v običajno nedostopnih mestih, kot je to človeško telo. Kristali so zelo preprosta oblika samosestavljanja: pod pravimi pogoji, se atomi naravno sestavijo skupaj v pravilne strukture, pogosto z dragocenimi lastnosti. Večina bioloških sistemov se navezuje na samosestavljanje pri nano-razdaljah, kjer se, pod ustreznimi pogoji v obliki molekul sestavljajo beljakovine s posebnimi oblikami in kemičnimi lastnostmi, kar vse skupaj tvori bolj zapletene sisteme in navsezadnje žive organizme. Raziskovalci nanotehnologije delajo na izvedbi naprednih materialov,ki se samo-sestavljajo v uporabne strukture v različnih okoljih. Potencialne aplikacije segajo od samosestavljive predloge za nanometrična integrirana vezja, do samosestavljivih bioloških struktur, ki so lahko v pomoč regeneraciji živčevja.

Enostaven samo-sestav, kot je kristalna tvorba, ne odpira posebno nove izzive. Vendar pa trije vidiki samozdruževanja in njegova uporaba v naslednji generaciji nanotehnologije povečuje potencialno nove izzive pri razumevanju in obravnavanju tveganja:

(1) preoblikovanje materialov na kraju samem iz ene oblike v drugo in pri tem na novo nastala snov ima za posledico zelo različne profile tveganja kot v primeru predhodne sestavine,

(2), nepredvidena in nenadzorovana samozdruževanja nanomaterialov na mestih, kjer bi lahko prišlo do škode, kot je to lahko v telesu ali okolju in

(3), možnost, da v nekaterih okoliščinah samo-sesatva lahko vzpostavi verižno reakcijo oblikovanja nanomaterialov, ki bi lahko bili škodljivi.

Čeprav trenutno ni nikakršne gotovosti, da so skbi upravičene, je potrebno skrbno proučevanje, ker smo priča vse bolj prefinjenega samosestavljanja nanomaterialov in naprav, ki so jim namenjeni in raziskovani.

Samo-kopiranje. Samo-kopiranje je mogoče razumeti kot razširitev samozdruževanja. Samo-sestavljanje ki vodi k rasti nanomateriala s ponavljajočo se strukturo je najpreprostejša oblika samo-kopiranja. Raziskani so bolj kompleksni sistemi , vključno s sistemi, ki uporabljajo nanometrične DNK ali druge "načrte (blueprints)" za razmnoževanje in rast drugačnih vzorcev. Ti sistemi so lahko namenjeni za gradnjo dvojnikov samih ali za gradnjo drugih sistemov. Ti in drugi pristopi se prekrivajo in se lahko kombinirajo. Rodemeyer (2009) ugotavlja, da "znanstveniki na Arizona State University so pred kratkim poročali, da bi bilo možno podvojitev celice DNA uporabiti kot postopek za izdelavo kopije načrtovane nanostructure DNA, kar kaže na prekrivanje poti sintetične biologije in nanotehnologije. Pravzaprav ... razlikovanja med obema disciplinama verjetno ne bo več." Nekateri raziskovalci si upajo prekiniti z biologijo in ustvariti popolnoma umetne (ne-biološke) nanometrične naprave, ki so sposobne proizvajati lastne kopije na precej enak način, kot to delajo celice. **Vendar pa je še veliko dvoma glede verjetnosti** da bi v bližni prihodnosti posnemali kompleksne ne biološke samopodvajajoče se sisteme.

Družba ima nekaj izkušenj nadziranja lastnega posnemanja sistemov v obliki gensko spremenjenih rastlin in organizmov. Vendar te izkušnje verjetno ne zagotavljajo dober zgled (model) za uravnavanje (regulacijo) napredkov na osnovi nanotehnologij, ki združujejo elemente bioloških in ne-bioloških sistemov. Strahovi ki se izražajo v samo-ponavljajočih nanotehnologijah,kot je scenarij"pretirane črnogledosti¸¨ so skoraj zagotovo neutemeljeni. Samo-posnemajoči sistemi potrebujejo pravo okolje in pravo »hrano« za preživetje in čeprav so znanstveniki bili sposobni ustvariti umetne samo-posnemalne nanonaprave, je zelo malo verjetno, da bi lahko preživele zunaj laboratorija. Kljub temu, razvoj in izzivi uporabe bolj realističnih samo-posnemalnih sistemov, je potrebno dobro razmisliti,če se želimo izogniti možnim nezaželenim posledicam.

V tem stoletju s pomočjo kombinacije nanotehnologije, umetne inteligence, računalništva in morda sintetične biologije bi bilo možno narediti stroj,ki je nekajkrat bolj inteligenten od ljudi. . Vernor Vinge, profesor matematičnih ved, je leta 1993 napovedal, da "v tridesetih letih, bomo imeli tehnološka sredstva za ustvarjanje nadčloveške inteligence. Kmalu zatem, se bo končala era humanih bitij" (Vinge 1993). Ta dokument niti ne napovedujejo konec človeške dobe in ne predlaga nadzornega sistema za samosestavljanje robotov, vendar je pomembno, da se zaveda, da bodo nekoč v prihodnosti tehnologije predstavljale izzive, ki jih v primerjavi s preteklostjo nismo še nikdar doživljali.

Naslednja generacija nanotehnologije bo razkoračila področja strokovnih znanj in uporabe v kompleksne načine, ki se bodo odzvali in se prilagodili okolju, v katerem se uporabljajo. Obstaja nevarnost, da zaradi njihove nevidnosti, bodo obravnavani s človeškega vidika kot preprosti atomi in molekule iz perspektive nadzora. To bi bilo enako neprimerno, kot da bi humana bitja obravnavali kot atome in molekule, iz katerih so narejeni. Namesto tega je potrebno novo razmišljanje o tem, kako zagotoviti varno uporabo nanometričnih izdelkov.

6. OBSTOJEČI NADZOR IN NASLEDNJE GENERACIJE NANOTEHNOLOGIJE

Vrsta dokumentov tega autorja in od drugih je preučila uporabo nadzornih mehanizmov ZDA za prve generacije nanotehnologij (glej navedbe). Vsi ti avtorji so ugotovili hude vrzeli in pomanjkljivosti v sedanjem nadzoru. Če obstajajo resne težave z nadzorom nad trenutno tehnologijo, ne bi smelo biti presenetljivo, da bodo težave nadzora bodočega tehnološkega razvoja še večje. Novi mehanizmi nadzora so potrebni.

Ta del teksta opisuje težave, ki lahko nastanejo, ko se sedanji sistem uporablja za naslednje generacije nanotehnologije. Čeprav se ta del osredotoča na nadzor v ZDA, se bodo nekateri sklicevali tudi na evropske institucije in politike. Začne se z opisom zahteve za ustreznim sistemom nadzora, tako da bralec ima osnovo za ovrednotenje sedanjega sistema. Nato analizira, kako bi se obstoječi nadzorni programi uporabljali za nove tehnologije.

6.1 Zahteve za ustreznim nadzorom nad sistemom

Ustrezen sistem nadzora, kot minimum,mora ustrezati zahtevi,da lahko oceni potencialna tveganja vezana na tehnologije, zmanjšati možnosti pojava tveganja in vzdrževati nadzor nad ugotavljanjem tveganja, ki se pojavi. Sistem bi opravljal te funkcije ob sočasnem zmanjševanju škodljivih vplivov na tehnološke inovacije ali funkcije na trgu in hkrati ob dajanju zaupanja javnosti, da je sistem učinkovit in omogoča javnemu mnenje, da se ga sliši.

Izhodišče za vsak nadzor nad sistemom je sposobnost za ugotavljanjem tveganja, ki ga lahko sproži tehnologija, ter za oceno verjetnosti in obsega teh tveganj. Takšna ocena zahteva tako splošna znanstvena spoznanja kakor tudi podatke o posameznih specifičnih tehnologijah in izdelkih.

Odnos med znanostjo in podatki je zapleten. Brez ustreznega znanstvenega okvirja skoraj ni možnosti da bi vedeli katere podatke je potrebno zbirati. Na primer, kateri vidiki nanomaterialov so najbolj primerni za določitev strupenosti? Kot je že bilo omenjeno, več kot ducat značilnosti je bilo predlagano tudi za relativno enostavne nanomateriale. Kaj bo potrebno dodatnega z bolj zapletenimi aktivnimi nanotehnologijami? Brez boljšega znanstvenimi poznavanja ne vemo, katere podatke zbirati in preučiti. Po drugi strani pa je napredek v razvoju potrebnega znanstvenega spoznanja pogosto odvisen od tega, koliko podatkov imamo o posebnih materialih. Le ob takšnih podatkih lahko razvijemo in preizkusimo potrebne znanstvene hipoteze.

Nadzor ne more neposredno izboljšati znanstvenih spoznanj. Lahko pa, vsekakor,razjasni potrebo po takšnem znanju, okvir vprašanj na katera je treba odgovoriti in z zahtevami naslovljenimi na proizvajalce, pridobiti potrebne podatke od znanstvenikov. Kako uporabiti ustrezen nadzor, ko stanje znanstvenih spoznanj ni primerno, je ena izmed osnovnih dilem pri razvoju in uporabi mehanizmov nadzora 21. stoletja. V večini primerov bo znanost v zvezi s tveganjem primitivna in negotova, vendar pa morebitna tveganja bodo dovolj resna, da bi pomanjkanje nadzora bila sprejemljiva možnost oziroma,da bi nadzor podcenjevali.

Ko so informacije o možnih tveganjih novega materiala ali izdelka pridobljene, ustrezen sistem nadzora mora biti sposoben postaviti zahteve, da bi se preprečilo pojave škodljivih učinkov ali vsaj zmanjšalo tveganja zaradi novega izdelka. To lahko storite na različne načine. Omejitve se lahko dajo na izdelek, kot pogoj za dovoljenje njegovega trženja. Lahko se določijo standardi, ki preprečujejo izpostavljenost delavca in okolja, medtem ko se izdelek proizvaja, prevaža, skladišči, uporablja ali odstrani. Omejitve in zahteve se lahko naložijo, potem ko se je izdelek že tržil, ali pa

proizvajalec sam zaradi novih spoznanj o tveganju lahko zahteva umik izdelka s trga v celoti. Dodatne ukrepe je mogoče sprejeti za spodbujanje okolju prijaznega oblikovanja in preprečevanja onesnaževanja.

Zaradi zapletenosti novih tehnologij in hitro vstopanje inovacij in njihovo še hitrejše sprejemanje, znanost samo verjetno ne bo zadoščala za popolno ugotovitev vseh tveganj novega materiala ali izdelka, ki jih bodo tehnologije povzročale. Iz tega razloga, še bolj kot v preteklosti, bo treba določiti zahteve in sisteme za ugotavljanje morebitnih škodljivih učinkov izdelka, potem ko je že v komercialni uporabi. Za njihovo učinkovito delovanje bo potrebna visoka stopnja mednarodnega sodelovanja.

Te zahteve nadzora je treba uporabljati s stalnim zavedanjem potrebe spodbujati tehnološke inovacije in gospodarsko rast. "Kavbojska ideologija", ki vidi regulacijo kot nasprotnika prostega trga se je izkazala za lažno v celi vrsti sektorjev. Produktivni trgi *zahtevajo* učinkovite regulacije. Vendar pa je nesporno,da obstajajo napetosti med njima. Ni verjetno, da bodo vladne agencije izboljšale njihovo učinkovitost, hitrost in dovolj veliko strokovnost,da bi šle v korak s tehnološkimi inovacijami. Da bi se izognili postavljanju velikih ovir razvoju inovacij bi se morali mehanizmi nadzora bolj zanašati na proizvajalce, da sami ocenijo in nadzirajo tveganja. Istočasno bi nadzor moral biti tako strukturiran, da bi zagotavljal proizvajalcem vedenje, katere informacije so potrebne, da zbira podatke na zanesljiv način in ne zlorablja njegove pristojnosti.

Večina obstoječih sistemov za nadzor pade daleč pod zgoraj navedena merila. Pregled, kako bi specifične sedanje organe nadzora veljale za nove nanotehnologije, razkriva veliko težav.

6.2 Uporaba obstoječega nadzora za naslednje generacije nanotehnologije

Obstoječe nadzor nanotehnologije se nanaša na tri kategorije: snovi, izdelki in odpadki. Vsaka kategorija predstavlja posebne vrste težav.

Nanomateriali ali snovi so regulirani v Združenih državah prek TSCA in v Evropi prek (**R** egistration, **E** valuation, **A** uthorization and Restriction of **Ch** emicals- REACH), uredbe o **Registraciji,vrednotenju, odobritvi in omejitvi kemikalij**. Izraz *snovi*, se uporablja v zakonodaji ZDA; *kemikalije*, se uporablja v pravu EU in *materiali*, se uporabljajo na področju znanstvenega in skupnega jezika. To poročilo uporablja tri termine sopomensko.

Pomanjkljivosti TSCA pa so bile dokumentirane tudi drugje (glej Davies 2006, 2007; Schierow 2007). Akt sploh ne more urejati obstoječih snovi. EPA je izrecno zavrnila preučevanje nanomaterialov kot nove snovi, razen če niso imele novo molekularno strukturo in zato številni nanomateriali niso urejeni. Celo 30 proizvajalcem ali blizu tega števila,katerih nanomateriali so bili spoznani za nove,razen v enem primeru, ni bilo potrebno predložiti podatkov o varnosti. EPA mora dokazati, da snov pomeni "nerazumno tveganje", preden lahko zahteva podatke, da ugotovi, ali snov predstavlja tveganje.

TSCA je bila sprejeta leta 1976 in se od takrat ni bistveno spremenila. REACH nasprotno, je relativno nova uredba, ki je bila sprejeta v Evropski uniji (EU) v letu 2007. Ta je izbrisala razlikovanje med starimi in novimi snovmi, in postavlja dokazno breme na proizvajalca, da dokaže, da je snov varna. Vendar pa je veliko zahtev REACH-a sproženih šele z obsegom proizvodnje, na splošno neprimernim merilom,ki bi se uporabljalo za nanomateriale. Že od sprejetja REACH-a sem je v teku razprava v Evropski komisiji (EK) o tem, kako je treba obravnavati nanomateriale v okviru uredbe. (Za trenutno stanje teh razprav glej European Commission 2008.)

Kot se bo razpravljalo v naslednjem delu tega dokumenta, se bo nadzor prihodnjih nanotehnologij verjetno moral osredotočiti na izdelke in ne na snovi, ker bo ista snov imela zelo različne učinke, glede na proizvode, v katerih se uporablja. Glede na to, bodo nove tehnologije predstavljajo velike težave tako za TSCA in REACH. Nanostructure sestavljene iz nekaj molekul se bodo štele za kemikalije? Če nanomateriali ali strukture spremenijo obliko, ko jih izpostavimo posebnim spodbudam, predvsem dražljajem, katera oblika je predmet ureditve? Če nanometrične snovi s samogradnjo ustvarjajo nove snovi, kako jih bo treba urejati? To so le nekateri od razlogov, da se je verjetno potrebno bolj osredotočati na proizvode. Čeprav je REACH veliko boljša, kot TSCA v njene sposobnosti za zaščito javnosti, se ne zdi verjetno da bi tudi ta regulativni sistem bil učinkovit pri zagotavljanju nadzora za nove nanotehnologije.

Nekateri regulativni programi v ZDA in Evropi se osredotočajo na posebne izdelke. V Združenih državah Amerike je poznano da proizvode ki vključujejo zdravila, medicinske pripomočke in aditive za živila ureja uprava za hrano in zdravila (Food and Drug Administration-FDA), pesticide in dodatke za gorivo, ki so registrirani pri upravi za zaščito okolja (Environment Protection Administration-EPA); govedino, perutnino in nekatere druge kmetijske izdelke, ki jih ureja oddelek za kmetijstvo (Department of Agriculture); cepiva, ki jih ureja Center za nadzor in preprečevanje bolezni ter preostala kategorija potrošniških izdelkov, za katere je v teoriji odgovorna komisija za varnost potrošniških proizvodov (CPSC- Consumer Product Safety Commission).Struktura v EU je podobno v smislu, da več kategorij proizvodov urejajo različne agencije, tako na nacionalni ravni kot v Evropski skupnosti. V ZDA na izdelke osredotočeni sistemi se razlikujejo po strogosti. Večina od njih je strožja na koncu spektra, postavljajo dokazno breme na proizvajalca in zahtevajo obsežno preskušanje varnosti. Vendar pa, kot je na primer na drugem koncu spektra, CPSC primanjkuje zakonske avtoritete in finančnih virov, da so po obsegu najbolj potrošniški izdelki v ZDA, za vse praktične namene, deregulirani (glej Felcher 2008). . Čeprav je več kot polovica nanoizdelkov v popisu PEN-a v pristojnosti CPSC je komisija do sedaj porabila le 20.000 $ na nanotehnologiji (na iskanju literature) *(Ibid.).*

Ker so posebne značilnosti posameznih proizvodov primerne za določitev neželenih učinkov, ki se lahko pojavijo, se bo nadzor v prihodnosti moral osredotočiti predvsem na izdelke. Osnovna težava, z vidika nadzora, je veliko število izdelkov, ki že obstajajo in veliko število novih, ki prihajajo na trg vsak dan. Poleg tega večina proizvodov ne predstavlja resno tveganje za zdravje ali okolje, tako da bi poskus urejanja vseh njih, tudi če bi bilo možno, bilo veliko zapravljanje virov. o Mogoče niti ni zaželeno, da bi vlada urejala vse proizvode in v prihodnosti bo še manj možnosti za to, ker se bo število ter izbor izdelkov povečala.

Tretja vrsta zakonodajnega programa se osredotoča na onesnaževanje in odpadke, ali, v primeru poklicne varnosti in zdravja, na delovna mesta. V Združenih državah Amerike so primeri kot so programi v okviru Čist zrak in zakoni Čiste vode, zakoni, ki se ukvarjajo z odstranjevanje nevarnih snovi in poklicne varnosti in zdravja. V EU je onesnaževanje obravnavano predvsem z direktivo o celovitem nadzoru in preprečevanju onesnaževanja (Integrated Pollution Prevention and Control - IPPC). Delovna mesta so urejena predvsem preko vlad držav članic.

Za nanotehnologijo in verjetno tudi za druge prihodnje tehnologije sta obe metodi za spremljanje in nadzor problematični. V odsotnosti ustreznega nadzora onesnaževanja in / ali kontrolnih metod, mora biti preprečevanje glavno sredstvo za zaščito ljudi in okolja. V Združenih državah Amerike, in po vsej verjetnosti tudi v Evropi, se bodo zakonodaje za odpadke osredotočale na onesnaževanje, ko bo le-to ustvarjeno. Te običajno niso zelo učinkovite pri preprečevanju onesnaževanja. Uporabnost zakonodaje za uravnavanje onesnaževanja je torej verjetno omejeno, zato bi večjo zanesljivost morali dati zakonom nadzora izdelkov.

Poleg tega bi zakoni za uravnavanje onesnaževanja lahko postali manj pomembni, ker bodo bolj zelene proizvodne metode pripomogle k zmanjšanju onesnaževanja že iz proizvodnih obratov. To ne pomeni, da bodo težave onesnaževanje izginile. Pravzaprav, številne študije so pokazale, da so

trenutne metode za proizvodnjo nanomaterialov pogosto energetsko intenzivne in uporabljajo različne strupene snovi (Sengul 2008; Kushnir in Sanden 2008; Healy 2008; Eckelman 2008; Singh 2008).Težko je oceniti rezultate teh študij, vsaj za nanomateriale, saj ne upoštevajo niti manjše mase proizvedenih nanomaterialov ali pa njihove okoljske učinkovitosti, ki izhajajo iz nano aplikacij. Na primer, ena študija (Kushnir in Sanden 2008) poudarja, da proizvodnja ogljikovih nanodelcev je "2 do 100-krat energetsko bolj intenzivna", kot proizvodnjo aluminija, toda preučitev meril za energetsko intenzivnost na maso proizvodnje, ne omenja, da je masa proizvodnje aluminija za pet velikostnih razredov večje od proizvodnje ogljikovih nanodelcev.

Neustreznost sedanjega sistema za spopadanje z novimi tehnologijami, je očitna. Zlasti v Združenih državah Amerike je regulativni nadzor bil vedno nekoliko pomanjkljiv in v zadnjih 30 letih se je dovolilo da se je poslabšal do te točke, ga lahko rešijo le velike spremembe. Na obeh straneh Atlantika, **ekstremne ideologije prostega trga so prispevale k eroziji nadzora**. Poleg tega je prišlo do napačnega pristopa za predvidevanje in analiziranje novih tehnologij, ki nastajajo in se tržijo na vedno večji stopnji uporabnosti.

Vrzeli v sistemu nadzora so izrazite. V Združenih državah Amerike, kozmetika in prehranska dopolnila sta obe vrsti izdelkov, ki uporabljajo nanotehnologijo in vključujejo visoko izpostavljenosti ljudi in so v skladu z zakoni, ki *prepovedujejo* oziroma onemogočajo učinkovit nadzor.

Dve od najpomembnejših težav sta velikost in obseg, vendar sta pogosto spregledani. Ena težava je v tem, da nobena država nima celovitega in usklajenega sistem nadzora. Obe ZDA in EU imajo posamezne programe, ki se ukvarjajo s posebnim vidikom nanotehnologije, vendar so ti programi razdrobljeni in neusklajeni. V Združenih državah Amerike ni prizadevanj za razvoj celovitega sistema za nadzor nanotehnologije, še manj pa ga je za ravnanje z drugimi novimi tehnologijami, ki bodo oblikovale 21. stoletje (glej, na primer, Rodemeyer 2009).

Druga težava je odsotnost institucij in mehanizmov za reševanje družbenih vplivov novih tehnologij. Nimamo dobrih načinov za obravnavo vplivov tehnologij ali pridobivanje prispevkov javnosti o vplivih novih tehnologij, zelo pogosto pa tudi nimamo dobrih orodij za spodbujanje družbe do pozitivnih učinkov in odvračanje do negativnih.

V naslednjem poglavju je opisan nov pristop za reševanje težav tehnologije nadzora.

7. PRIHODNOST NADZORA

Ta del raziskuje, kako bi lahko izgledal bolj ustrezen sistem. Predlagani pristop v veliki meri ni nadgradnja primarnega, ker po avtorjevem mnenju, je obstoječi sistem tako pomanjkljiv in so novi izzivi, tako drugačni od tistih iz preteklosti, da bi bila napaka poskusiti se z njimi spopasti s krpanjem obstoječega sistema. Politični sistem deluje postopoma, razen ko se sooča s krizo, in je prisotno goreče upanje, da se kriza ne pojavi v zvezi z nano ali katero koli drugo tehnologijo. Vendar,na dolgi rok, politični sistem odgovarja za modele, na katerih bi lahko ali bi morali obstajati nadzorni sistemi. Cilji in ideali, četudi so oster odmik od statusa quo, lahko vplivajo na razmišljanje oblikovalcev politike in javnosti. Veliko sprememb, opisani spodaj bodo zahtevale desetletje ali morda še več za njihove izvršitve, vendar je nujno potreba začeti razmišljati o njih sedaj.

Predlogi, podani v tem poročilu, naj bi bili začetek dialoga in ne predmet za njihovo sklepanje. Namen je opozoriti na potrebo po reformi in osnovnem okvirju za velikost in smer potrebnih sprememb. Če bodo predlogi katalizirali resno razpravo o politikah nadzora za spopadanje s težavami v prihodnjih desetletjih, potem bo to poročilo doseglo svoj namen.

Nov sistem potrebuje novo organizacijo, nove pravne organe in nova orodja za nadzor. To poglavje začenja z opisom nove hipotetične organizacije, oddelkom za okolje in varstvo potrošnikov. Nato, ko opisuje nove oblasti in orodja, ki bi bila potrebna in osvetlitev narave nove organizacije, prispevek obravnava reguliranje izdelkov, onesnaževanje, spremljanje in ocenjevanje tehnologije. Vsaka od teh bi bila osnovna funkcija nove agencije. Končno poglavje analizira nekaj dodatnih pomembnih področjih, ki zahtevajo nove pristope –ocenitev tveganja, ojačitev, mednarodno sodelovanje in vključevanje javnosti. Vsaka od teh funkcij podaja preseke osnovnih organizacijskih gradnikov, opisanih v prejšnji točki.

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7.1 Institucionalni okvir

Nov sistem nadzora je nujno potreben tako zaradi obžalovanja vrednega stanja sedanjega sistema kot zaradi narave novih izzivov, ki jih predstavljajo tehnološke spremembe.

Značilnosti nove tehnologije so bile opisane zgoraj. Sedanji sistem nadzora je bil zasnovan za reševanje problemov tehnologije parnega stroja v okviru pred-računalniškega gospodarstva. Ta je temeljil na predpostavkah, da je največ težav na lokalni ravni, da je programe mogoče razdeliti, razmejiti in ločiti drug od drugega, da se tehnologija spreminja počasi in da so bile ugotovljene vse pomembne težave. Vsi ti koncepti niso več veljavni, če so sploh kdaj bili.

Zastarela konceptualna podlaga sistema je postala še bolj očitna z močnim odlivom denarja in delovne sile iz sistema, ki je trpel zaradi neustreznih sredstev. Vendar pa viri sami zase niso vse, kar je potrebno. Novi koncepti, nove vrste organizacij in nova orodja, so potrebni za zagotovitev znanja in prožnosti za učinkovit nadzor.

Nova struktura nadzora v 21. stoletju zahteva bolj celostne pristope na vseh ravneh. Sedanji razdrobljen sistem je bil sprejemljiv tako dolgo, kolikor so bile težave omejene glede na področje uporabe in ugotovljene v manjšem merilu obsega. To ni več tako. Problemi 21. stoletja imajo potencialno velik vpliv, ki ni omejen le na posamezno geografsko območje. Oni ne spadajo in ne bodo spadali v oddelke razmejene z veljavno zakonodajo.

Na ravni posameznih programov, razdrobljenost sedaj ovira učinkovitost. Obstaja skoraj več programov za uravnavanje onesnaževanja, kot lahko kdorkoli prešteje, tako da sta nadzor in preprečevanje onesnaževanja prikrajšana, ker sedanje vladne uredbe se osredotočajo na ozko onesnaževanja zraka, vode ali različnih oblik odstranjevanja. Drugo področje, spremljanje stanja okolja je neučinkovito in nezadovoljivo zaradi več agencij ,ki poizkušajo spremljati medsebojno povezane dele okolja, tako da vsaka agencija počne to na svoj način.

Na širši ravni, se lahko urejanje različnih vrst izdelkov pridobi od črpanja podatkov na isti raziskavi tveganja ali enakih sistemov za spremljanje neželenih učinkov. Različne vrste raziskav prav tako lahko izkoristijo podatke od enotnega vira spremljanja. Obstaja še veliko takšnih sinergij.

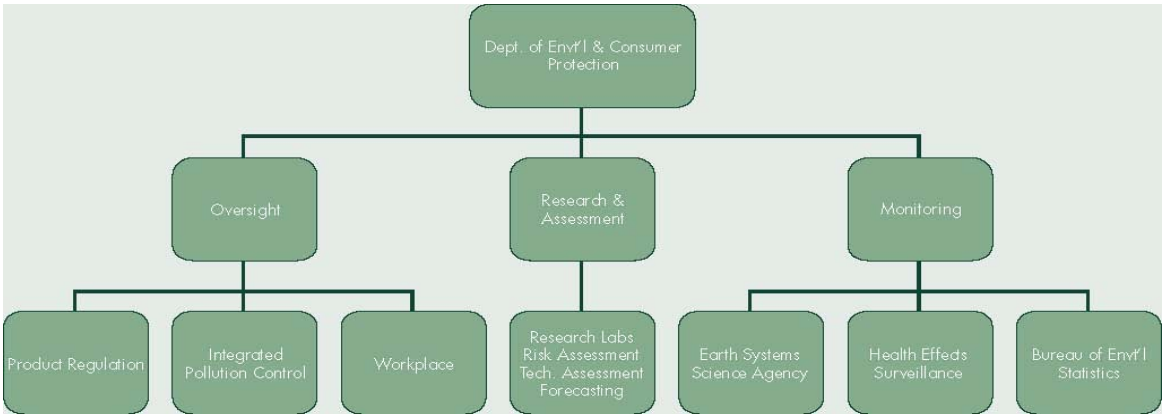
Druga nujnost,ki jo je potrebno povečevati je znanstvena podpora, ki temelji na visoki kakovosti raziskav in da so te ustrezne za potrebe nadzora. V Združenih državah Amerike, sta tako EPA kot FDA imeli prednost hišne znanstvene podpore, vendar je obseg podpore nezadosten. Nedavno poročilo pododbora FDA za znanost je navedel: "FDA ne more izpolniti njenega poslanstva, saj je njena znanstvena podlaga izginila in je znanstveno organizacijska struktura slaba" (FDA ZDA 2007, str. 3). FDA in EPA sta imeli težave privabljanja in ohranjanja dobrih znanstvenikov, ker večina znanstvenikov raje dela za znanstveno agencijo kot pa za nadzorno agencijo.

Za razliko od sedanje EPA in FDA, ki sta agenciji za nadzor z znanstveno komponento, bi nova agencija lahko bila znanstvena agencija z nadzornim delom oziroma komponento. Tako

raziskovalna kakor ocenjevalna komponenta ter spremljanje kot del nove agencije, bi se osredotočila na področje znanosti in vsak od teh delov bi bil verjetno večji od nadzornega dela. Znanstvena kompleksnost problemov 21. stoletja zahteva nadzorne agencije, ki imajo močne znanstvene usposobljenosti.

Dodatna potreba je po zakonih in organizacijah, ki so dovolj prožne, da se odzovejo na tehnološke značilnosti in spremembe, opisane v prvem delu tega dokumenta. Obstoječe ameriške zvezne nadzorne agencije so bile na splošno premajhne, da bi imele veliko prilagodljivost. Vse njihove vire so namenjale za preživetje in uspešnost minimalno zahtevanih funkcij. Imele so omejene sposobnosti predvidevanja in odzivanja na nove težave ali za preučitev novih načinov za izvajanje dejavnosti.

Soočanje s temi potrebami bi zahtevalo tako novo zakonodajo kakor novo organizacijo. Ta kratek dokument ne zajema novih zakonov do vseh podrobnosti, čeprav v nadaljevanju so nekateri predlogi vključeni v razpravo. Nova organizacija, ki bi zagotovila več povezovanja, boljšo znanost in več prožnosti je opisana na sliki 2.



SLIKA 2. Hipotetično Ministrstvo za okolje in varstvo potrošnikov

Organizacija upodobljena na sliki 2 bi lahko bila bolj primerna podlaga za nadzor kot jo ponuja sedanji sistem. Ta bi se osredotočila na nadzor izdelkov, onesnaževanje in na delovno mesto in to na bolj celosten način. Poleg nadzorne funkcije, bi organizacija imela glavne sestavine namenjene za spremljanje in raziskovanje. Raziskovalna funkcija bi obravnavala tudi ocenjevanje in napovedovanje tehnologije.

Nova agencija bi izvajala veliko možnih sinergij med različnimi funkcijami in programi kot je prikazano na sliki 2 in bi tako olajšala vključitev tesno povezanih programov. Čeprav se ta dokument osredotoča na nanotehnologijo, bi reorganizacija izboljšala sposobnost vlade pri obvladovanju skoraj vseh večjih okoljskih in potrošniških programov. Na primer bi omogočala raziskave in modeliranje podnebnih sprememb, da bi prišle pod eno agencijo (v okviru raziskovalne naloge in spremljanja). Ista agencija bi bila odgovorna za nadzor emisij toplogrednih plinov (vključen pod nadzorno funkcijo). Vodstvo agencije bi lahko oblikovalo splošne podnebne politike ob izkoriščanju koristnih nasvetov in sicer iz znanstvenih in regulativnih sestavnih delov agencije.

Nova agencija bi vsebovala šest obstoječih agencij: EPA, US Geological Survey (USGS), National Oceanic Atmospheric Administration (NOAA), Occupational Safety and Health Administration (OSHA), Nacionalni inštitut za varnost in zdravje pri delu (National Institute of Occupational Safety and Health -NIOSH) in CPSC. Nove enote bi bilo treba postaviti za oceno tveganja, napovedovanje, presojo tehnologije, spremljanje zdravja in urad za statistiko okolja.

V dodatku je ocena potrebnih človeških in denarnih virov za hipotetično agencijo. Ocene temeljijo na sedanjem obsegu delov agencij povečane za dodatne dolarje in osebje, ki temeljijo na oceni

dodatnih potreb. Predlagana agencija bi bila med manjšimi kabineti zveznih služb, vendar ne najmanjši. V zvezi s polnim delovnim časom (FTE) osebja, na primer, bi bil ta deset krat večji od ministrstva za šolstvo in štirikrat večji od ministrstva za stanovanja in urbani razvoj. Vendar pa bi bil za polovico manjši od finančnega ministrstva in eno četrtino velikosti ministrstva za domovinsko varnost.

Nove agencija, bi bila znatno večja od sedanje EPA ali od katerega koli drugih zveznih organov nadzora. Funkcije nadzora bi morale biti umeščene v večji organizaciji, ne le zaradi razmerja med velikostjo in prožnostjo kot je navedeno zgoraj, ampak tudi zaradi trenutne majhnosti regulativnih agencij, kar jih dela bolj občutljive, da bi lahko postale še manjše. Zamisel "veliko postaja večje" se zdi v organizacijskem smislu enako kot pri bogatih, ki postajajo še bogatejši. Manjše agencije imajo manj vpliva in so manj sposobne, da vplivajo na politiko v primerjavi z večjimi agencijami. Razen političnega vidika, že sama majhnost agencij nadzora jim preprečuje, da bi lahko namenile veliko virov za nove probleme in v 21. stoletju se bodo problemi pojavljali pogosto.

Večje agencije lahko imajo slabosti počasnega spodbujanja in togega odločanja in odvračajo od inovacij in ustvarjalnosti. Za zmanjšanje teh pomanjkljivosti bi bilo dobro da veliko sestavin nove agencije lahko delujejo z dobro mero neodvisnosti. Uspeh nove organizacije bi v veliki meri bil odvisen od stopnje do katere bi lahko našla dobro ravnotežje med vključevanjem in neodvisnostjo sestavnih delov.

Prav tako bi lahko dodali novi agenciji druge funkcije. Na primer, programi na področju varnosti pri hrani, ki so trenutno razpršeni med štirimi zveznimi agencijami, bi bili lahko združeni v predlaganem oddelku. Vendar pa ta funkcija in druge funkcije tukaj niso vključene, ker so predmet drugih zakonodajnih predlogov ali drugih razlogov zunaj obsega tega dokumenta. Razmislek bi bilo treba posvetiti tudi vzpostavitvi komisije, ki naj preuči sestavo nove agencije, kot tudi morebitnih novih zakonov in orodij nadzora.

7.2 Uredbe izdelkov

Osrednje vprašanje nadzora je ali bi se moral osredotočiti ali na materiale ali na izdelke. Odgovor bo določil številne najbolj pomembne parametre sistema nadzora. Sedanji sistem nadzora je osredotočen tako na materiale kakor izdelke. Materiali so urejeni po TSCA in REACH; različne vrste izdelkov (npr. zdravila, pesticidi in goveje meso), so urejeni z vrsto drugih zakonov.

Materiali so snovi s posebnimi lastnostmi. TSCA jih opredeljuje kot snovi s posebno molekularno sestavo, čeprav je treba velikost ali obliko dodati kot ustrezno značilnost, da se lahko ukvarjajo z nanotehnologijo. Ostale lastnosti materiala, kot je na primer radioaktivnost je lahko tudi ustrezna (pomembna) za nadzor.

Izdelki so predmeti, ki se prodajajo javnim potrošnikom, proizvajalcem ali drugim. Proizvodi lahko gredo skozi več faz, vsaka faza je lahko poseben izdelek. Na primer, ogljikove nanocevke lahko (en izdelek) kombiniramo s plastiko in tako sestavljen izdelek se uporablja za avtomobilsko ogrodje (drugi proizvod) in je ta spojina vključena v končni izdelek avtomobil (tretji izdelek). Material je ponavadi proizvod in isti material je mogoče vključiti v številne izdelke.

Sistem nadzora, ki temelji le na proizvodih bi lahko bil boljši od sedanjega mešanega sistema. Način kako se material uporablja, način kako je kombiniran z drugimi materiali in drugi dejavniki so ključnega pomena za ugotavljanje, ali se pojavijo neželeni učinki (Kraljevska komisija za onesnaževanje okolja, 2008). Zato materiali, sami po sebi ne zagotavljajo dobre podlage za ocenjevanje tveganja. Če nekatere vrste ogljikovih nanocevk povzročijo azbestnemu-tipu podobne težave, na primer, se je tem težavam mogoče izogniti s kombiniranjem nanocevk z drugimi materiali, ki se jih uporablja le v zaprtih sistemih ali z manjšimi spremembami v obliki nanocevk. Uredbe izdelkov bodo zajele te razlike; uredbe materialov tega ne bodo zmogle. Kje je mogoče

vzpostaviti sistem nadzora, ki temelji na proizvodih raje kot na materialih bo odvisno od tega kako sistem zgleda.

Vsaj dve načeli bi bili osnova za nadzor nad izdelki. Prvič, nadzor mora vključevati življenjski cikel izdelka, proizvodnjo, uporabo in odstranitev. Prevoz je tudi del življenjskega cikla, vendar ga lahko ureja ločeno Ministrstvo za promet. Drugič, stopnja nadzora, kar pomeni strogost zakonskih zahtev, bi morala biti povezana s pričakovano škodo,ki bi ga izdelek povzročil. To je funkcija resnosti pričakovane škode in verjetnosti, da se bo to zgodilo.

Za vlado verjetno ni pomembno da ima podrobne in aktualne informacije o sestavi izdelka, o njihovi predvideni uporabi ali o njihovih pričakovanih učinkih. Samo proizvajalec bi lahko vedel ali bo pridobil te informacije pravočasno. Zato mora vlada neizogibno biti odvisna od proizvajalca, da bo zanesljivo preskusil izdelek in točno poročal ustrezne informacije vladi. Kazni za izkrivljanje, prikrivanje in izogibanje pridobivanja zahtevanih podatkov morajo biti dovolj visoke za odvračanje od takšnega ponašanja.

V prejšnjem poročilu (Davies 2006, str 19) je bilo predlagano, da zahtevane informacije proizvajalca je potrebno vključiti v trajnostni načrt (-Sustainable plan-SP), ki bi ga proizvajalec sestavil. Načrt bi bilo potrebno zahtevati za vsak izdelek. Načrt bi vseboval povzetek znanih informacij o sestavnih delih proizvoda, škodljivih učinkih proizvoda, analizi življenjskega cikla proizvoda, ki opisujejo njegovo uporabo,način odstranjevanja (umika) in obrazložitev zakaj izdelek ne bi povzročal prekomernega tveganja. Vlada bi čim bolj natančno opredelila kateri podatki so potrebni in kaj predstavlja prekomerno tveganje. Tveganje bi vključevalo mehanske nevarnosti (npr., od motorne žage ali zrušitev otroške posteljice), kot tudi kemična in biološka tveganja. Zdi se razumno zahtevati da vsak proizvajalec izdelka ima (pozna) te informacije pred prodajo izdelka. Vlada lahko zahteva dodatne informacije za posebne kategorije izdelkov. Trajnostni načrt ali SP bi bilo treba posodobiti, če proizvajalec izve za nove informacije, ki vplivajo na tveganost izdelka.

Številna podjetja izdajajo samoiniciativno izjave, podobne trajnostnemu načrtu. Na primer, Apple je izdal okoljsko poročilo o svojem MacBook Air prenosnem računalniku (images.apple.com / environment / resources / pdf /-MacBook Air-EnvironmentalReport.pdf). Poročilo vsebuje poglavja o podnebnih spremembah, energetski učinkovitosti, učinkovitosti materialov, prepovedanih snoveh in recikliranju. DuPont, v sodelovanju z Environmental Defense je razvil okvir za analizo tveganja nanomaterialov (www.nanoriskframework.com). Okvir velja za vse nove nanoizdelke DuPont-a. Za mnoge kemikalije, ki bi bila podobna SP oceni kemijske varnosti, zahteva REACH.

Ker bi vsak izdelek (razen tistih, izvzetih) moral imeti SP, bi proizvajalci lahko vedeli možna tveganja pri komponentah, ki jih uporabljajo, in bi jih zahtevali od njihovih dobaviteljev skupaj s SP-si za sestavne dele. To bi bila velika pridobitev za proizvajalce kompleksnih izdelkov, kot so avtomobili. Trenutno so lahko proizvajalci avtomobilov zakonsko odgovorni za težave zaradi sestavin, ki jih uporabljajo, lahko pa da imajo nepraktičen način ugotoviti kakšne nevarnosti lahko imajo sestavni deli. REACH (člen 34) zahteva, da se informacije o tveganju prenesejo od vsakega udeleženca v dobavni verigi naslednjemu udeležencu ali distributerju iz dobavne verige.

Posebna prizadevanja bodo potrebna za obveščanje malih podjetij o zahtevah in zagotavljati tem podjetjem tehnično pomoč, da zadostijo zahtevam. Različne programe je mogoče uporabiti za to. Mala podjetja ne bi smeli biti izvzeta iz nadzora, ker nekateri od najbolj nevarnih proizvodov so narejeni s strani malih proizvajalcev, in ni razumno pričakovati, da bodo lahko ocenili nevarnosti ne glede na to da svoje proizvode lahko predstavljajo.

Kaj bi lahko naredili z načrtom trajnosti, katere dodatne informacije, če sploh, bi morali vsebovati, bi bilo odvisno od škode ki jo izdelek lahko povzroči. Možna tipologija je, kot sledi:

Kategorija 1: Ta kategorija je za proizvode, ki imajo zelo majhno verjetnost da povzročajo škodljive učinke. Za to kategorijo ne bi bilo nadzora; SP bi proizvajalec le obdržal, oziroma, če ne bi bila prisotna očitna tveganja, se lahko od proizvajalcev proizvodov izvzeti iz zahteve SP v celoti. Primeri izdelkov kategorije 1 so knjige, pohištvo in nekatera industrijska orodja, verjetno 70-90 odstotkov vseh izdelkov v trgovini. Vedno pa mora obstajati možnost, da bodo novi dokazi premakniti izdelek iz kategorije 1 v drugo kategorijo.

Kategorija 2: V to kategorijo bi se uvrstili izdelki, za katere bi bili dovolj ukrepi obveščanja o tveganju da bi zadostovali za preprečevanje škodljivih učinkov. Proizvajalcu bi bilo potrebno uporabljati SP kot osnovo za list varnosti izdelka, ki ga je treba nameniti uporabnikom in / ali označevanju za potrošnike. Primeri izdelkov v tej kategoriji bi vključevali nekaj gospodinjskih izdelkov za čiščenje in industrijski katalizatorji, ki se porabljajo v proizvodnem procesu.

Kategorija 3: Post-tržni pregled SP, ki ga izvaja vlada. Ta kategorija bi bila sestavljena iz skupine enega ali dveh izdelkov kjer obstaja sum, da povzročajo škodljive učinke, potem ko so bili prodani. Vlada bi imela pooblastila za ustavitev proizvodnje in / ali distribucijo teh izdelkov do pregleda njihove varnosti.

Kategorija 4: Ta kategorija bi bila se za proizvode, ki imajo določeno stopnjo verjetnosti povzročanja škodljive posledice za zdravje ali okolje. Tu bi se izvajal pred-prodajni pregled izdelka. Izdelki v kategoriji 4 bi vključevali pesticide, dodatke za gorivo in proizvode, ki vsebujejo določene vrste materialov (na primer, obstojna organska onesnaževala).

Vlada bi opredeliti kategorije in odločala kateri proizvodi sodijo v posamezne kategorije. V kolikor je to mogoče, bi vlada dodelila široke razrede izdelkov za določene kategorije. Če bi proizvajalec želel proizvajati izdelek, ki ni bil vključen v eno od prej dodeljenih razredov, bi moral predložiti zahtevo vladi, da določi, v katero kategorijo izdelkov sodi proizvod.

Za kategoriji 3 in 4, bi dokazna obveza bila na proizvajalcu, da dokaže, da so podatki v SP bili veljavni in ustrezni in da so podprli sklep, da izdelek ne bi ali ne predstavlja prekomerne nevarnosti. Vlada bi morala pokazati nekaj vzrokov za uvrščanje izdelkov v kategorijo 3.

Kot je navedeno zgoraj, je glavni izziv pri urejanju izdelkov ogromno število proizvodov na trgu v danem trenutku. Na primer, CPSC nadzira 15.000 vrst izdelkov in vsaka vrsta vsebuje številne posamezne izdelke. Neizogibno je dejstvo da bi število izdelkov, uvrščenih v vsaki kategoriji do neke mere bilo določeno z razpoložljivimi viri, ki so na voljo vladni agenciji nadzora. Za prvi dve kategoriji bi bilo treba samo preverjanje na kraju samem, ki ga izvaja vlada in 3. kategorije bi verjetno uporabljali le za relativno majhno število proizvodov. Kategorija 4 bi zahtevala intenzivno uporabo državnih resursov. Upoštevati bi bilo potrebno da bi se plačilo za odobritev izdelka vršilo s pristojbinami, kot je to sedaj v praksi pri registraciji zdravil, ki jih izdaja FDA, čeprav bi bilo potrebno sprejeti določene ukrepe, da se prepreči nekaj težav s sistemom FDA. Upoštevati je treba tudi to, da je javnosti redno in pravočasno obveščena kljub prisotnosti nastajanja razlik med možnostmi (potrebnimi viri) in zahtevami nadzora. To je mogoče storiti tako, da se zahteva od agencije, da redno objavlja število izdelkov, ki bi jih bilo treba pregledati, vendar do pregleda ni bilo na voljo dovolj virov.

7.3 Celovit nadzor onesnaževanja okolja

Nadzor onesnaževanja je nadzor ali preprečevanje škodljivih odpadkov. *Onesnaževala* so nezaželeni stranski produkti proizvodnje ali uporabe. Za razliko od materialov ali izdelkov, nimajo vrednosti in cilj nadzora je lahko zmanjšanje onesnaževal na najmanjšo možno količino. Ta cilj se ne uporablja za materiale in izdelke, ker – dokler imajo še vrednost-, je treba njihove koristi za družbo pretehtati napam stroškom njihovih škodljivih učinkov. Tudi v zvezi s strupenimi snovmi je

treba upoštevati koristi, ki jih ponujajo. Onesnaževala, ki jih je mogoče reciklirati postanejo, strogo gledano, proizvodi, saj ko bo nekdo plačal zanje, bodo imeli neko vrednost.

Ločilne meje v katere je bil nadzor nad onesnaževanjem segmentiran, so bistvena ovira pri obravnavi sedanjih in prihodnjih težav. Na primer, nadzor nad nanodelci, ki se sproščajo med proizvodnjo, mora temeljiti na preprečevanje izpustov, ki se pojavljajo. Poskus za reševanje problema, ki ga posebej urejajo izpusti v zrak, vodo ali na tla, kot ga ureja sedanji zakon, ne bo deloval.

V Evropi je celovit nadzor onesnaževanja okolja realnost (US EPA 2008). Leta 1996 je EU odobrila direktivo IPPC. Direktiva je pooblastila vsako članico EU da vzpostaviti sistem, ki temelji na dovoljenju celovitega preprečevanju onesnaževanja za vsak objekt. EU vzpostavlja mehanizem za pomoč državam s takšnim sistemom, zlasti z oblikovanjem posameznih sektorjev, kjer navaja najboljše razpoložljive tehnologije, standarde ,ki jih je treba vključiti v vsako dovoljenje. Dovoljenje IPPC ne pokriva le odlaganje v zrak, vodo in tla, pač pa tudi zadeve, kot so energija in uporaba vode, hrup in vonj, nesreče in razgradnja objekta.

Kot je navedeno v izčrpnem poročilu ameriške vlade o IPPC dovoljenjih v Združenem kraljestvu, "ZDA nimajo ustreznega, all-inclusive okoljskega zakona za obravnavo novih izzivov na osnovi celovitosti, stalnosti in odkritosti." (US EPA 2008, p. xi). Kot je za ZDA značilno, morajo navadno imeti desetine okoljskih dovoljenj (Davies 2001). Vsak zvezni program (nadzor onesnaževanja zraka, itd) zahteva več različnih vrst dovoljenj in poleg zveznega dovoljenja obstajajo še državna in lokalna dovoljenja. Velik objekt bo potreboval več obsežnih kabinetov (ali več megabajtov računalniške prostora) za vsebnost različnih dovoljenj,ki jih bo hranil. Sistem ne le da rezultira v birokratska podvajanja in zmedo, temveč tudi omogoča neprosojnost v javnosti. Poleg tega, zaradi razdrobljenosti, ne nadzira velik del vpliva objektov na okolje. (prav tam.). Čeprav EU sistem IPPC-ja deluje v političnem in kulturnem kontekstu različno od Združenih držav, bi Združene države imele večje korist od sprejetja pristopa, kot to sedaj velja za EU.

Povezava med nadzorom izdelkov in nadzorovanju onesnaževanja (odpadkov) ni bila dovolj raziskana na obeh straneh Atlantika. Uredba materialov in izdelkov je lahko v nekaterih primerih, najbolj uspešen in učinkovit način preprečevanja in zmanjševanja odpadkov. V Združenih državah Amerike je povezava priznana tako,da TSCA pooblašča EPA administracijo, med drugim, da ureja proizvodnjo, uporabo in odstranjevanje snovi, ki predstavlja, ali bo predstavljala nesprejemljivo tveganje (TSCA sec. 6 (a)). Vendar so ti organi le redkokdaj uporabljeni. V 30-letni zgodovini TSCA je EPA uporabila te organe za urejanje vsega skupaj šest obstoječih kemikalij (Schierow 2007, str 17). Zelo verjetno je, da bo za reševanje problemov v prihodnje, zakonodaja za nadzor nad izdelki morala postati bolj pomemben del varstva okolja.

7.4 Nadzor in ocenjevanje tehnologij

Tehnologijo je mogoče opredeliti bodisi kot celoto znanstvenega znanja in njegove uporabe ali kot praktično uporabo določene celote znanstvenih spoznanj. V primeru, da opredelitev vključuje znanstvena spoznanja, bi verjetno bilo nemogoče urejanje te vrste znanj in tudi če bi bilo možno, bi bilo neproduktivno. Nadzor se osredotoča na nadzor uporabe tehnologije. Vsekakor da črto med znanostjo in njenimi aplikacijami je verjetno težko potegniti, zlasti ko gre za socialne posledice tehnologije. Bi nov material, ki je omogočil človeškim možganom rast nevronov prištevali k znanosti ali njeni uporabi? Osredotočanje na posebne uporabnosti lahko zgreši splošne vplive tehnologije, in do takrat, ko vplivi uporab postanejo jasni, je za učinkovito vplivanje na smer lahko že prepozno,ko tehnologija zapelje kam drugam. Z le nekaj izjemami (npr. jedrske elektrarne), tehnologija kot taka ni in ne bi smela biti regulirana v istem smislu, kot je treba urejati proizvode in odpadke. Vendar pa nadzor prevzame različne oblike tako kot pri uredbah.

Vplivi novih tehnologij na družbo v 21. stoletju bodo ogromni. Mi jih lahko obravnavamo do neke mere, ki jim omogoča urejanje izdelkov, surovin in odpadkov. Toda mnogi najpomembnejši vplivi ne bodo zajeti v okviru teh kategorij. Ko nekdo razmišlja o vplivih avtomobilov na družbo, onesnaževanje zraka se ne zdi, da bo med največjimi po pomenu, kot je to sedaj v resnici. Tri stvari so potrebne za nadzor nad tehnologijo:

(1) Ocena vplivov tehnologije, zlasti nenamernih vplivov;

(2) načini kako javnost razume vplive tehnologije in kako zajame njihova stališča,

(3) **načini pri vladi, da prevede javno mnenje v dejanja.** Nobena od teh zahtev ni bila zadovoljivo izpolnjena.

V nekem smislu se oceno tehnologije izvaja ves čas. Meritve onesnaževanje iz različnih virov, modeliranje vplivov podnebnih sprememb in ocenjevanju bodočih prodaj računalnikov so vsi elementi ocenjevanja tehnologije. Vendar pa je potrebna določena sposobnost, da se preuči celotne učinke glavnih novih tehnologij in da se to stori tako,da še vedno obstaja čas, da se lahko ukvarjamo z vplivi. To zahteva sposobnosti napovedovanja kakor tudi sposobnosti ocenjevanja. Tehnike za to napovedovanje in ocene še niso bile deležne pozornosti, ki jih potrebujejo. Ne po naključju, so institucije za izdelavo napovedi in izvajanje ocen šibke ali pa jih sploh ni (glej Davies 2008, str. 23-24).

Vključevanje javnosti v ocenjevanje novih tehnologij povzroča veliko težav. Treba je razumeti, da javnosti ki *bodo* sodelovale , bodo nastopale politično in gospodarsko, kot protestniki ali podporniki ali odjemalci. Vendar pa je sodelovanje vzpostavljeno večinoma po tem, ko je tehnologija že usidrana. Prihodnost svetovnega prebivalstva bo oblikovana z novimi tehnologijami, vendar je ponavadi tako da ljudje nimajo možnosti razmisliti katere tehnologije je treba spodbujati, katere je treba preprečevati in kako se spopasti s posledicami in učinki posamezne tehnologije preden se učinki pojavijo .

Kako naj vlada vpliva na smeri novih tehnologij je tudi zamotano vprašanje. Vlada sedaj izvaja velik vpliv s pomočjo finančne podpore za zasebne raziskave in razvoj, s sredstvi za obrambo in drugimi znanstveno intenzivnimi programi in predpisi vlade (ali z odsotnostmi predpisov) za različne dejavnosti. Vsi ti sprejeti ukrepi so navadno postopni, brez usklajene strategije za skupno tehnološko prihodnost sveta ali celo za prihodnost posamezne tehnologije.

Pozornost je potrebno posvetiti analogiji uporabe izjavam, ki jih običajno označimo kot "družbeni vpliv izjave", in jih podajamo kot izjave o okoljskih vplivih s strani vladnih projektov. Izjave bi zagotavljale neko sredstvo za obveščanje javnosti pri spoznavanju nove tehnologije in bi tako javnost kakor vlada razmislili, katere ukrepe, če sploh katere, je treba sprejeti za maksimiranje pozitivnih učinkov tehnologije in katere za čim večje zmanjšanje škodljivih učinkov. Kdo bi pripravil takšne izjave, kdaj naj bi bile pripravljene, kaj bi bil njihov obseg in raven podrobnosti in kako bi jih bilo potrebno razširjati, so vse vprašanja, na katere bi bilo potrebno odgovoriti.

Posamezne vladne agencije je potrebno da se bolj zavedajo njihovega vpliva na tehnološki razvoj in vpliv tehnologij na družbo. Za takšno pobuda je primer vojska, ki nam je dala veliko število pomembnih tehnologij od DDT do interneta. Ministrstvo za obrambo mora vzpostaviti odbor pregleda obrambnih tehnologij da bi pretehtali civilne kot tudi vojaške posledice nove vojaške tehnologije. Člani odbora bi morala biti seznanjeni z vsemi vidiki raziskav in razvoja za obrambo. Takšno telo bi zagotavljalo nasvete tako za vojaške službe in svetovalcu za znanost predsednika.

7.5 Spremljanje

Spremljanje je bistven del nadzora. Zagotavlja povezavo med vladnimi ukrepi in resničnim svetom. Institucija opisana v sliki 2 bi izvajala dve vrsti spremljanja- okolja in ljudi.

Spremljanje stanja okolja v Združenih državah vsebuje širok nabor funkcij, ki jih izvaja več agencij. Pred kratkim je neodvisna skupina strokovnjakov za politiko znanosti predlagala združitev dveh največjih agencij, NOAA in USGS, v enotno, neodvisno Earth Systems Science Agency (Schaefer . 2008). NOAA ima proračun v višini skoraj 4 milijard USD in 12.000 zaposlenih. USGS pa 1 milijardo USD proračuna in 8.500 zaposlenih (Ibid). Struktura na sliki 2 bi sprejela predlog strokovnjakov , vendar bi Earth Systems Science Agency bil pri delu polovično odvisen od predlaganega oddelka za ekologijo in varstvo potrošnikov. Del oddelka za spremljanje bi vključeval tudi EPA funkcijo spremljanja in urada za okoljsko statistiko, podobno kot pri statistiki urada za delo. Predlog odbora je bil podan že pred približno 20. leti in je večkrat prišel blizu, da postane zakon, vendar ni nikoli do tega prišlo zaradi drugih dejavnikov.

Dodatno k Earth Systems Science Agency je treba upoštevati spremljanje zdravja ljudi kot sestavni del. Zaradi negotovosti v oceni tveganja za nove tehnologije, bodo nekatere negativne posledice za nove proizvode verjetno izpuščene, ko se bo proizvod prvič tržil. Te posledice ne bodo določene, dokler ne bo izveden obsežen sistem nadzora, ki bo pokazal na vložke nenormalnih pojavov, kot je večje število primerov zaradi bolezni ali konice v sprejemu na urgenci. Vse to presega okvir tega dokumenta da bi zagotovil podrobnosti o takem sistemu, vendar mora biti usklajen z drugimi domačimi in mednarodnimi zdravstvenimi sistemi poročanja in ga je treba kar najbolj nevsiljivo vpeljati.

7.6 Ocena tveganja

Razprava o tem prinaša nekatere podrobnosti o glavnih sestavinah prikazanih na sliki 2. Štiri funkcije so prisotne v večini delov: ocene tveganja, izvrševanje, mednarodno sodelovanje in vključevanje javnosti. Vsaka od teh bo deležna razprave v okviru tehnologij 21. stoletja.

Ustreznost nadzora nad novimi tehnologijami bo odvisna od naše sposobnosti za napovedovanje tveganj,ki jih tehnologije predstavljajo. Napovedovanje tveganja vključuje osnovne znanstvene podatke o tehnologiji, test podatkov o posebnih izdelkih in ocene tveganja. Vsaka od teh komponent ima drugačen izvor in različne lastnostmi.

Osnovne znanstvene informacije prihajajo predvsem iz univerz in javnih ali vladnih laboratorijev. . Motivi za razvoj znanstvenih informacij vključujejo znanstveno radovednost, možnost pridobivanja nepovratnih sredstev in pogodb kakor tudi pridobivanja denarja prek patentov in / ali novoustanovljena podjetja. Uresničevanje družbene potrebe, kot je ugotavljanje tveganja novih tehnologij, pogosto ni upoštevana v večji meri pri določitvi prioritet osnovne znanosti. To je eden od razlogov, zakaj je pomembno da vladne agencije za nadzor imajo svoje znanstvene vire.

Preskušanje posebnih proizvodov se primarno izvaja predvsem pri njihovih proizvajalcih, bodisi interno ali s pomočjo pogodbenih laboratorijev. Viri vladnih agencij za preskus številnih proizvodov so premajhni in skoraj v vsakem primeru bo izdelovalec najbolje seznanjen z izdelki, ki jih proizvaja.

Testiranje novih vrst proizvodov je lahko problematično. Na primer, pogosto ni znano katere končne točke (npr. rak, astma, umrljivost rib) naj se poišče pri preskušanju nano materialov, niti se ne razume, katere lastnosti materiala, so povezane z neželenimi učinki. V odsotnosti testiranja, se sklepe o varnosti izdelka ali materiala pogosto veže na podobne materiale, ki so bili testirani. Vendar pa po definiciji, nove vrste materialov in proizvodov, ki nimajo natančno primerljivih

podobnosti, je potrebno testirati. Ko so tehnologije evolucijske, kot jih je v nanotehnologiji veliko, lahko analogija sicer pomaga napovedati vedenje, vendar s tem to še vedno na splošno niso alternativa testiranja. Tehnologija testiranja se sama po sebi spreminja in je bil dosežen napredek pri razvoju testov, ki so veliko hitrejši in cenejši od sedanjih preskusov, ki se zanašajo na laboratorijske preizkuse na živalih (Service 2008).

Vrsta ocene tveganja, ki ga običajno opravi vlada, se je razvil v visoko razvit sklop postopkov. Oceno tveganja je treba uporabiti če so nosilci odločitev vlade s tem usmerjeni k razumnim odločitvam.

Ocena tveganja je bila razvita za potrebe nosilcev odločanja. Ni izhajala iz kakršnihkoli znanstvenih vprašanj in ocene navadno niso znanstveni izdelki, so način organiziranja in analiziranja podatkov o določeni snovi ali izdelku. Niso znanstvena, saj jih je le v nenavadnih primerih mogoče empirično preveriti. Značilna ocena tveganja lahko privede do ugotovitve, da bo snov X povzročila Y število dodatnih primerov raka na izpostavljenosti milijon ljudi. Vendar ali je Y nič ali 1000, v resnici nikoli ne bodo znana števila in običajno so neznana zato, ker je preveč drugih vzrokov za raka. Regulativne odločitve je skoraj vedno treba sprejeti na podlagi teže razpoložljivih dokazov. Dokončnih znanstvenih dokazov običajno ni, čeprav drži da več razpoložljivosti uporabne znanosti omogoča lažjo ocenitev tveganja in verjetnost bolj natančne ocene.

Ker je treba odločitve običajno temeljiti na izravnavi razpoložljivih dokazov je privzeta predpostavka o tem, kdo ima dokazno breme izredno pomembno. Rodemeyer (2009) je ugotovil, da »je v mnogih primerih informacija o tveganjih za nove tehnologije preprosto nerazpoložljiva ali nejasna«. V takšnih primerih, je odločitev regulative odvisna od privzete politike predpostavk glede varnosti tehnologije. Po drugi strani pa je privzeta politika predpostavk oblikovana z okvirjem novih tehnologij v odnosu do obstoječih tehnologij. (Glej tudi Jasanoff 2005.)

REACH predvsem postavlja obremenitev na proizvajalca,da dokaže varnost, TSCA jo postavlja pred vlado, naj dokaže tveganje. To omogoča REACH-u bolj učinkovito zakonodajo nadzora. Industrija občasno trdi, da je obremenitev potrebno prevaliti na vlado, ker ni mogoče dokazati varnosti, vendar je to varljiv argument. Zato ni mogoče dokončno dokazati varnosti proizvoda, tako kot je običajno nemogoče dokončno dokazati tveganje. Tveganje in varnost sta operativno opredeljena z zahtevanimi preizkusi in enako težavno je dokazati eno ali drugo.

7.7 Uveljavljanje

Uveljavljanje ima dve razsežnosti, **povezane spodbude in skladnosti.** Močnejše kot so spodbude, boljše so skladnosti, vendar ti dve dimenziji vključujejo različne ugotovitve.

Naraščajoča hitrost pohoda tehnoloških inovacij in raznolikosti novosti otežujejo uporabo veliko starejših pristopov uveljavljanja. Novejši pristopi so poudarili gospodarske spodbude in prilagodljivost. Odgovornost je bila uporabljena kot velika spodbuda v enem zakonu ZDA o odpadkih (Celovit odgovor na onesnaževanje, Kompenzacija in Zakon o odgovornosti iz leta 1980), in bilo bi mogoče, na primer, da bi proizvajalec bil pravno odgovoren za neuspeh pri izdelavi načrta trajnosti ali katerokoli škodljivo posledico, ki bi jo bilo možno razumno predvideti, vendar ni bila vključena v načrt. Spodnji nivo za uporabo odgovornosti in sodnih postopkov pri izvajanju regulativnega nadzora je ta, da bi ljudje v vladi porabili velike količine časa za pričanja na sodišču, podajanja izpovedi in prisostvovanja pri razsvetljevanju na druge načine. To bi lahko resno vplivalo na njihovo sposobnost za opravljanje svoje primarne naloge (Mark Greenwood, osebna komunikacija).

Cap-and-trade programi, kot je bil eden uporabljen v uredbi ZDA za emisijo žveplovega dioksida iz elektrarn, so bili predlagani kot nadomestilo za veliko obstoječe strukture za nadzor onesnaževanja

(glej http://www1. Law.nyu. edu / konference / BTL / index.html; dostopa 11/11/08).Takse in dajatve za odpadne vode so se uporabljale tudi v nekaterih situacijah in so bile priporočene kot pristop, ki bi se lahko uporabil tudi širše. Ni jasno, ali bi se te vrste pristopov lahko uporabile za nadzor uporabnih izdelkov (v nasprotju z odpadki) in na najmanj, je potrebna previdnost pri predlaganju, da se spodbude razvita za omejevanje odpadkov se uporabljajo za uporabne izdelke.

Zavarovanje je dodatna spodbuda, da je nadzor lahko pomemben. Uporablja se lahko bodisi negativno ali pozitivno. Negativno, kot je v primeru,ko je zavarovalnica že zavrnila zavarovanje za morebitno škodo, povezano z nanotehnologijo (Rizzuto 2008), zaradi pomanjkanja ustreznih informacij o tveganju. Če druga podjetja ustrezno sledijo napotkom, je to lahko velika spodbuda za več raziskav in več testiranja proizvodov s strani zasebnih podjetij. Zavarovatelji lahko zavrnejo zavarovanje proizvajalcem, ki niso imeli načrta trajnosti. Na pozitivni strani bi se lahko zavarovanje dalo proizvajalcev v odškodninski zahtevi v primeru,da je ta imel načrt trajnosti in v njem predmet morebitne škode, ki je bil vključen v načrt.

V zvezi s skladnostjo z načrtom , je verjetno je ključno vprašanje, v kolikšni meri se prostovoljno izpolnjevanje zahtevka lahko sklicuje. Odgovor je odvisen od kulturnega konteksta in se lahko razlikuje med Evropo in Združenimi državami Amerike. Vsaj za Združene države Amerike velja, da se je nadzor v številnih kontekstih pokazal kot metoda, ki je za prostovoljno izpolnjevanje neodvisna. Pravno izvršljiva zahteve, se pravi pravnomočne, se običajno uporabljajo za reševanje običajno majhnega, vendar pomembnega deleža podjetij, ki niso odgovorne do državljanov.

7.8 Mednarodno sodelovanje

Velika soodvisnost svetovnega gospodarstva in skoraj trenutna komunikacija med vsemi narodi omogoča in hkrati povzroča mednarodno težo tega problema. Vsaka nadzorna funkcija, od raziskave do pregona ima sedaj pomembne mednarodne razsežnosti. In izziv je sedaj ta,da poosebimo to mednarodno razsežnost v učinkovite inštitucije.

Mednarodna spletna organizacija obstaja. EU že sama zase je sama mednarodna organizacija. Organizacija za ekonomsko sodelovanje in razvoj (OECD), ki vključuje večino industrializiranih narodov, je sprejela vrsto pobud, povezanih z novo tehnologijo. Dogovorili so se da preverijo in testirajo 14 generičnih nanomaterialov glede njihovih vplivov za zdravje in okolje in so vzpostavili bazo podatkov za njihovo izmenjavo pri raziskavah o morebitnih škodljivih učinkih proizvedenih nanomaterialov (http://www.oecd.org/document/26/0, 3343, en_2649_37015404_42464730_1_1_1_1 , 00. html). Združeni narodi ima več ustreznih inštitucij, pomembnih za nadzor, vključno s Svetovno zdravstveno organizacijo, programom ZN za okolje in Mednarodne organizacije za delo. Mnoge nevladne mednarodne organizacije, vključno z mednarodnimi združenji za trgovino in mešane javno-zasebne organizacije, kot je Mednarodna organizacija za standardizacijo, igrajo pomembno vlogo pri prizadevanjih za ustrezen nadzor.

Na dolgi rok je možno doseči zavezujočo mednarodno ureditev za nadzor, razvoj izdelka, na način da ustrezajo mednarodni trgovini z izdelki. Najmanj, kar bi morale ZDA in EU regulativni pristopi doseči je njihova skladnost (glej Breggin in Falkner 2009). V vmesnem času je poudarek na izmenjavi informacij.

Vsaj tri vrste informacij, morajo biti na voljo na mednarodni ravni:

(1) rezultati raziskav o škodljivih učinkih tehnologije,

(2) **standardi, predpisi in druge politike**, ki se uporabljajo za nadzor izdelkov ali tehnologij,

in (3) **poročila o vseh škodljivih posledicah za zdravje ali okolje**, ki se pojavijo in da jih lahko pripišemo izdelkom.

OECD se je na začetku osredotočil zlasti na prvi dve. Tretja vrsta informacije je pomembna funkcija, ki jo je treba podpreti, morda s skupnim prizadevanjem Svetovne zdravstvene organizacije in Programa Združenih narodov za okolje. Mednarodni sistem za poročanje o neželenih učinkih, bi moral močno nadgraditi obstoječi sistem nadzora.

Ker je dokument nastajal v času svetovne gospodarske krize in po propadu pogajanj iz Dohe o mednarodnih trgovinskih pogajanjih, je prihodnost vseh mednarodnih prizadevanj negotova. Eden izmed izhodov ali rezultatov sedanje krize bi se lahko odražal v močnejši vrsti mednarodnih institucij, ki bi lahko vključeval tudi osnovo za sistem na mednarodni ravni za ukvarjanje z novimi tehnologijami in izdelki.

7.9 Vključenost javnosti

Preglednost mora biti znak za dejavnosti nadzora. Brez nje, se javni interes običajno potopi pod interese birokratov, politikov in posebne interese. Preglednost postaja še celo bolj pomembna v smislu novih tehnologij, ker če javnost čuti , da se skrivnosti zadržujejo in da so motivi skriti , se lahko zgodi, da nove tehnologije zavržejo ,ne glede na koristi,ki bi iz njih izhajale. Kot je Mednarodni svet za upravljanje tveganj (2007, str 8) ugotovil, bodo nove tehnologije zahtevale več sodelovanja javnosti, ker se pričakuje, da bodo njihovi vplivi na razvoj družbe,gospodarstva in politike močno posegli v smislu spreminjanja." Izziv, kot se je izrazila komisija za onesnaževanje okolja združenega kraljestva(2008, str 72), "je najti način in sredstva s katerimi bi se lahko civilna družba vključevala s socialno, politično in etično razsežnostjo v družbeno sprejemljive tehnologije in na ta način demokratizirala njihovo" dovoljenje za delovanje "... izziv premika od upravljanja tveganj k upravljanju inovacij. "

Akt o raziskavah in razvoju nanotehnologije 21.stoletja, zakon, ki ureja nano raziskave v Združenih državah Amerike zahteva od koordinacijskega urada nacionalne nanotehnologije, da zagotavlja " prispevke javnosti in ozaveščanja, ki bodo vključeni v [National Nanotechnology] Program s pomočjo rednih in priložnostnih javnih razprav, prek različnih mehanizmov, kot so paneli državljanov, konference za konsenz in izobraževalne dogodke, primerno posameznim potrebam "(PL 108-153, sec. 2 (b) (10) (D)). Nacionalna fundacija za znanost je že eksperimentirala z nekaterimi od teh tehnik, vendar na splošno, je bilo premalo ali zelo malo truda vloženo v izvajanje tega dela zakonodaje. Druge države so prav tako eksperimentirale z novimi javnimi mehanizmi sodelovanja pri obravnavi teh novih tehnologij (glej, na primer, Jones 2008).

V okviru nadzora nad novimi tehnologijami, je vključenost javnosti pri razmišljanju možno uvrstiti v tri skupine:

(1) dostopnost do notranjih informacij prek predstavnikov industrije, nevladnih organizacij, akademskih strokovnjakov, predstavnikov sindikata;
(2) delno obveščena javnost
(3) drugače prisotna javnost

Večina prebivalstva, spada v kategorijo drugače prisotna javnost. Običajno ta del javnosti ne ve veliko o novih tehnologijah in ne sledi temu, kar vlada dela na tem področju ali kaj govori o tem. Vendar pa lahko tudi drugače prisotna javnost vpliva na nadzor s svojo vlogo kot potrošniki, in prek proizvodov, ki jih kupijo ter pridobijo mnenja o njih ter tako prispevajo nabor mnenj notranjih informacij.

Politični cilj takšnega ukrepa je bil premakniti ljudi iz drugače prisotne javnosti v kategorijo obveščene javnosti. To je v skladu s pogledom predsednika Jeffersona na demokracijo in je pomemben način za zmanjšanje možnosti, da bi se javnost odzvala proti tehnologija na osnovi propagande ali dezinformacije .Kako si uspešno prizadevati za obveščanje javnosti, katere metode

bi bilo dobro uporabiti in kako potegniti črto med informacijami prizadevanja in propagando so pomembna področja, ki presegajo okvir tega dokumenta.

7.10 Pot pred nami

To je kratek dokument, ki pokriva širok spekter tem. Predhodna poročila zlasti še (Davies 2008), so se nanašala na izvajanje ukrepov, ki jih je za izboljšanje nadzora nanotehnologije mogoče sprejeti kratkoročno. Ta dokument pa je imel za cilj širiti pokritost tematike, da bi na ta način prišli do predlogov za nove mehanizme nadzora in zajeti vse nove tehnologije, ne le nanotehnologije. Prav tako dokument razteza časovni okvir, pri čemer je poudarek na tehnologiji in politike v naslednjih nekaj desetletjih.. Dokument je tudi nekakšna vaja o obeh temah :tehnološkega napovedovanja tehnološkega razvoja ter politike predvidevanja. Če so napovedi o tehnologijah točne, pa četudi v grobem, so razmišljanja o novih politikah nujno potrebna.

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9. DODATKI- Tržni in podatki o proizvajalcih

9.1 Nanotehnologije v uporabnih izdelkih

1. Electronic products

No.	Product	Technology	Material	Function
1	Camera image sensor	-	-	-
2	Camera lenses	coating	-	Anti-reflective
3	Cell phone surface	coating	Ag	Antibacterial
4	Computer	-	Ag	Antibacterial
5	Computer main chip	etching, coating	-	-
6	Computer memory	etching, coating	-	-
7	Computer cooling fan	coating	CNT	-
8	Conducting film	composite	CNT	-
9	Display protection	coating	-	Surface protect
10	Electron emitter	-	CNT	-
11	Guitar string	coating	-	-
12	Hard disk drive	etching, coating	-	-
13	Hearing aid	coating	-	Anti-adherent
14	Image sensor	etching, coating	-	-
15	Mouse, key board	coating	TiO2, Ag	Antibacterial
16	Photo paper	coating	-	Durability

-: information is not available-informacija ni dosegljiva

2. Automobile products

#	Product	Technology	Material	Function
1	Air filter	nanofiber	-	-
2	Body side molding	composite	Clay	-
3	Cargo bed	composite	Clay	lighter, protect
4	Cylinder head gasket	particle	-	sealing
5	Engine oil additive	particle	Au	-
6	Exhauster catalyst	-	Palladium	longer life
7	Fuel additive	particle	CeO2	fuel efficiency
8	Fuel system	composite	CNT	anti-static
9	Motor oil filter	fiber	-	-
10	Paint additive	coating	CNT	lighter, protect
11	Road safety glow	-	-	-
12	Side view mirrors	coating	TiO2	Self-cleaning
13	Surface treatment	coating	-	Anti-scratch
14	Tire additive	particle	Si, C-black	-
15	Wheel rim cleaner	coating	-	cleaning
16	Window cleaning	particle	-	-
17	Window sunscreen	coating	TiO2	UV filter
18	Electric car battery	particle	TiO2	-

3 Food and beverage products

No.	Product	Technology	Material	Function
1	Bottle brush	particle	Ag	Antibacterial
2	Chopstick	particle	Ag	Antibacterial
3	Cup	particle	Ag	Antibacterial
4	Cutting board	particle	Ag	Antibacterial
5	Food container	particle	Ag	Antibacterial
6	Kitchenware	particle	Ag	Antibacterial
7	Oil	particle	-	-
8	Pacifier	particle	Ag	Anti-bacterial
9	Plastic beer bottle	composite	Clay	Barrier
10	Plastic storage bag	particle	Ag	Antibacterial
11	Plastic wrap	catalysis	ZnO	-
12	Silver liquid	-	Ag	-
13	Supplement	particle	Au, Pd, Ag	Cu, Ti, Ca
14	Tableware	particle	Ag	Antibacterial
15	Teapot	particle	Ag	Antibacterial
16	Wet wipe	particle	Ag	Antibacterial

4. Cosmetic products

No.	Product	Technology	Material	Function
1	Al powder	particle	Al	-
2	Cleaner	particle	Ag	-
3	Conditioner	-	-	-
4	Eye cream	-	-	Moisture ctrl.
5	Facial creams	particle	C60	Moisture ctrl.
6	Facial spray	particle	Cu	-
7	Fullerene powder	-	C60	-
8	Hair treatment	-	-	-
9	Hand cream	-	-	Moisture ctrl.
10	Lipstick	particle	ZnO	-
11	Lotion	-	-	Moisture ctrl.
12	Mask pack	particle	Au	-
13	Shampoo	particle	Ag	Antibacterial
14	Skin renewal	-	-	Moisture ctrl.
15	Soap	particle	Au	-
16	Sunscreen	particle	TiO2,ZnO	UV protection
17	Toothpaste	particle	Ag	Antibacterial

5. Textile products

No.	Product	Technology	Material	Function
1	Blanket	-	Ag	Antibacterial

2	Elbow, knee guard	Particle coating	-	Antibacterial
3	Fabric softener	Particle	Ag	Antibacterial
4	Face mask	-	Ag	Antibacterial
5	Full body suit	-	-	Heat shield
6	Glove	-	-	-
7	Hat	-	-	-
8	Jacket	-	-	Retain dirt
9	Luggage bag	-	-	Stain resistance
10	Mask	-	-	Air filter
11	Mat	fiber	-	Antibacterial
12	Necktie	-	Ag	Antibacterial
13	Pants	-	-	Moisture mgmt
14	Pillow	Particle coating	Ag	Antibacterial
15	Shirt	-	-	Antibacterial
16	Shoe pad	-	-	Antibacterial
17	Sleeves & brace	-	Ag	Antibacterial
18	Slipper	-	Ag	Antibacterial
19	Socks	Particle coating	Ag	Antibacterial
20	Towel	-	-	-
21	Water short	-	-	UV protect

6. Appliance products

No	Product	Technology	Material	Function
1	Air conditioner	filter	Ag	Antibacterial
2	Air purifier	filter	TiO2	Antibacterial
3	Audio cable	-	C	-
4	Battery	nanoparticle	phosphate	-
5	Fuel cell	catalyst	-	-
6	Humidifier	coating	Ag	Antibacterial
7	Power tool battery	particle	TiO2	-
8	Refrigerator	coating, insulation	Ag	Antibacterial
9	Shaver	-	Ag	Antibacterial
10	Vacuum cleaner	coating	Ag	Antibacterial
11	Washing machine	coating	Ag	Antibacterial

7. Home and gardening products

No.	Product	Technology	Material	Function
1	Air spray	particle	Ag	Antibacterial
2	Artificial teeth cleaner	particle	Ag	Antibacterial
3	Bed mattress	-	-	Moisture control
4	Bottle brush	-	Ag	-
5	Chopstick	-	Ag	Antibacterial
6	Cigarette filter	fiber	-	Filtration
7	Cushion	-	-	Stain resistance

8	Degreaser	-	-	-
9	Deodorant	-	ZnO	-
10	Door lock	coating	Ag	Antibacterial
11	Epoxy coating	coating	-	Protection
12	Fish tank cleaner	-	-	Antibacterial
13	Floor cleaner	-	-	-
14	Glue	-	-	-
15	Grooming kit	-	-	Antibacterial
16	Hairbrush	particle	Ag	Antibacterial
17	Hair iron	coating	Ag	Antibacterial
18	Handler	coating	Ag	Antibacterial
19	Lens cleaner	coating	-	Prot. & clean.
20	Lubricant	coating, particle	inorganic	Lubrication
21	Makeup tool	coating	Ag	Antibacterial
22	Mosquito repellent	particle	-	-
23	Nail moisturizing	-	ZnO	-
24	Paint additive	coating	-	Antibacterial
25	Paper coating	coating	-	Prot. & clean.
26	Pet products	coating	Ag	Antibacterial
27	Photocatalyst spray	-	-	-
28	Respirator	-	Ag	Antibacterial
29	Self-cleaning window	coating	TiO2	Self-cleaning
30	Shoe-cleaning kit	-	Ag	-
31	Sticker	-	-	Deodorizing
32	Thermal patch	-	-	Antibacterial
33	Toilet	-	-	-
34	Toothbrush	particle	Ag	Antibacterial
35	Tooth developer	-	Ag	Antibacterial
36	Toy	particle	Ag	Antibacterial
37	Umbrella	-	-	Moist control
38	Watch chain	coating	Ag	Antibacterial
39	Water filter	membrane	-	-
40	Water tap	coating	Ag	Antibacterial
41	Wet wipes	-	Ag	Antibacterial
42	Wood coater	coating	-	Protection
43	Outside wall paint	coating	TiO2	Self-cleaning
44	Mirrors	coating	TiO2	Self-cleaning
45	Building glasses	coating	TiO2	Self-cleaning
46	Interior tiles	coating	TiO2	Self-cleaning
47	Exterior tiles	coating	TiO2	Self-cleaning

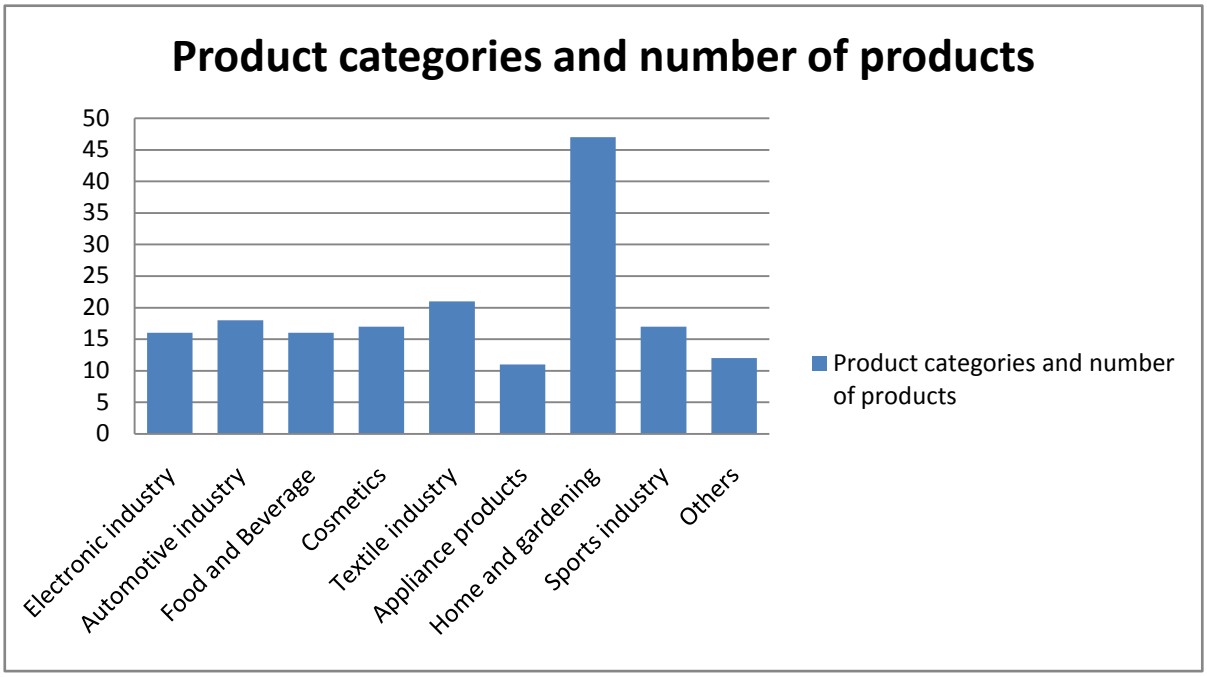
8. Sports products

No.	Product	Technology	Material	Function
1	Badminton racket	composite	SiO2	Lightweight, strong

2	Baseball bat	composite	CNT	Lightweight, strong
3	Bicycle frame	composite	CNT	Lightweight, strong
4	Bowling ball	composite	-	-
5	Crampon	composite	-	Lightweight, strong
6	Fishing lures	coating	-	-
7	Fishing rods	composite	Ti	Lightweight, strong
8	Fog eliminator	coating	-	Cleaning
9	Golf ball	composite	-	-
10	Golf shaft	composite	-	Lightweight, strong
11	Hockey sticks	composite	CNT	Lightweight, strong
12	Ice ax	alloy	Fe-Al	Lightweight, strong
13	Ski	particle	SiO2	Lightweight, strong
14	Ski wax	coating	-	Water-repellent
15	Snowboard	-	-	-
16	Tennis ball	composite	-	Lightweight, strong
17	Tennis racket	composite	CNT	Lightweight, strong

9. Other products

No.	Product	Technology	Material	Function
1	Chem.haz.res.sys	-	-	-
2	Condom	-	Ag	Antibacterial
3	Metal alloy	-	-	lightweight
4	Pain relief cream	-	-	-
5	Pencil lead	-	-	-
6	Pregnancy tester	particle	Au	color change
7	Vaccine adjuvant	particle	CaP	Drug delivery
8	Wound dressing	particle	Ag	Antibacterial
9	Roofing	coating	TiO2	self-cleaning
10	Tents	coating	TiO2	self-cleaning
11	Road soundproof walls	coating	TiO2	self-cleaning
12	Road mirrors	coating	TiO2	self-cleaning



9.2 Podjetja iz nanotehnologije

9.2.1 Ogljikove nano cevke-Seznam proizvajalcev in njihova spletna stran

	Company name	Products	Location	Web sites
1	Advanced nanopower	MW	Taiwan	www.anp.com.tw/English/main01.htm
2	Ahwahnee, Inc	MW	CA	http://www.ahwahneetech.com/
3	Alfa Aesar	MW	MA	www.alfa.com/
4	AlphaNano technology	SW, MW	CHI	www.nanotubes.cn/index-en.htm
5	American Elements	SW, MW	CA	http://www.americanelements.com/
6	ApNano materials	CNT	NY	www.apnano.com
7	Apex Nanomaterials	SW, MW	CA	http://www.apexnanomaterials.com/
8	Applied nanotech	CNT	TX	www.appliednanotech.net
9	Applied science	CN Fiber	OH	http://www.apsci.com/home.html
10	Arkema	MW	FRA	http://www.arkema-inc.com/index.cfm/
11	ARRY international	SW, MW	Hong Kong	www.arry-nano.com/
12	BASF	MW	GER	www.plasticspotal.com/products/ultraform.html/
13	Bayer MateScience	MW	GER	http://www.baytubes.com/
14	Bio-nano international	CNT	Singapore	www.bionano.com.sg/
15	Biophan	CNT	NY	www.biophan.com/
16	BuckyUSA	SW, MW	TX	http://buckyusa.com/
17	Buhler Partech	-	GER	www.buhlergroup.com
18	Canatu	CNT	Finland	www.canatu.com
19	CarboLex, Inc.	SW	PA	http://carbolex.com/
20	Carbon design innovation	CNT tip	CA	www.carbondesigninnovations.com
21	Carbon nanomaterial technology	SW, MW	KOR	www.carbonnano.co.kr/english.htm
22	Carbon nanotube and fiber 21	SW, MW	Austria	www.carbon-nanofiber.com
23	Carbon NT&F21	CNT, CNF	Australia	www.carbon–nanofiber.com
24	Carbon Solutions	SW	CA	http://www.carbonsolution.com/
25	Catalystic materials	MW	NC	www.catalysticmaterials.com
26	Cheap Tubes, Inc.	SW, MW	VT	http://www.cheaptubesinc.com/
27	Chengdo organic chemicals	CNT	CHI	www.timesnano.com
28	Cnano	SW, MW	CA	http://www.cnanotechnology.com/
29	Cnanoz	CNT	NC	http://cnanoz.com/index.html
30	C-polymers	CNT, CNF	Austria	www.c-polymers.com
31	Dupont	CNT	DE	www.dupont.com
32	E-City Nano Technologies	SW	MD	http://www.ecitynanotech.com/
33	eikos	-	MA	www.eikos.com
34	Electrovac	CNF	Austria	www.electrovac.com
35	Fujitsu laboratories	CNT	JPN	www.jp.fujitsu.com/group/labs/en/
36	Future carbon GmbH	MW	GER	www.future-carbon.de
37	Graphene Solutions	-	WI	http://www.graphenesolutions.com/home
38	Hanwha chemical	SW, MW	KOR	http://hcc.hanwha.co.kr/English/index.html

39	HeJi	SW, MW	CHI	www.nanotubeseu.com
40	Helix material solution	SW, MW	TX	www.helixmaterial.com
41	Hodogaya chemicals		JPN	www.hodogaya.co.jp/English2/web/
42	Honjo chemical	CNT	JPN	www.honjo-chem.co.jp
43	Hyperion catalyst	MW	MA	www.fibrils.com
44	IBM	CNT	NY	www.research.ibm.com/Nanoscience/nanotubes .html
45	Innovations unified technologies	CNT	India	www.iutechnologies.com
46	Ionic Liquid technologies	SW, MW	GER	www.nanomaterials.iolitec.de
47	Liftport	-	NJ	www.liftport.com/nanotech.htm
48	Lockheed Martin	CNT	CA	http://www.lockheedmartin.com/
49	MER corporation	-	AZ	www.opus1.com/~mercorp/index.htm
50	MicroTechNano	SW, MW	IN	http://www.microtechnano.com/
51	Mitsui	-	JPN	http://mitsuichemicals.com
52	MK nano	SW, MW	Canada	www.mknano.com
53	Molecular Nanosystems Inc	-	CA	http://www.monano.com
54	mPhase technologies	CNT	NJ	www.mphase.com
55	MysticMD	CNT	CT	www.mysticmd.com
56	Nanergy	CNT	NJ	www.nanergyinc.copm
57	Nano Factor Materials Tech.	SW, MW	IND	www.nanofactortubes.com
58	Nano NB	SW, MW	Canada	www.nanonb.com
59	NanoRidge	CNTcomp	TX	http://www.nanoridge.com/index.html
60	Nanostructure & Amorphous	SW, MW	TX	www.nanoamor.com
61	Nano-C	SW	MA	www.nano-C.com
61	Nanocarb lab	SW	Russia	www.nanocarblab.com
62	Nanocomp Technologies	-	NH	http://www.nanocomptech.com/
63	Nanocomposites	CNT	TX	www.nanocompositesinc.com
64	NanoCompound	MW	GER	www.nanocompound.de
65	NanoCS	SW, MW	NY	www.nanocs.com
66	Nanocyl	SW, MW	GA	www.nanocyl.com
67	NanoIntegris	SW	IL	http://www.nanointegris.com/
68	Nano-lab	SW, MW	MA	www.nano-lab.com
69	nanoledge	CNT	CNA	www.nanoledge.com
70	NanoMas technologies	CNT	NY	www.nanomastech.com
71	Nanomaterials research unit	SW, MW	Thailand	http://physcis.science.cmu.ac.th/nano
72	Nanomix Inc	-	CA	http://www.nano.com/
73	Nanoselect	CNT	DE	www.nanoselect-sensors.com
74	Nanoshel	CNT	India	www.nanoshel.com
75	Nanotailor	SW	TX	http://www.nanotailor.com/
76	NanotechLabs	CNT	NC	www.nanotechlabs.com
77	Nanothinx	SW, MW	Greece	www.nanotubesx.com
78	Nantero	CNT	MA	www.nantero.com
79	Natural nano	-	NY	www.naturalnano.com
80	N-tech	CNT	Norway	www.n-tech.no
81	NTP	SW, MW	CHI	www.nanotubes.com.cn
82	Optomec	CNT	NM	www.optomec.com
83	PlasmaChem	MW	GER	www.plasmachem.de
84	Polytech & Net	MW	GER	www.polytech-net.de
85	Porifera	CNT membrane	CA	http://poriferanano.com/
86	Pyrograph Products	CNF	OH	http://www.apsci.com/ppi-markets.html
87	Raymor nanotech	SW	Canada	www.raymor-nanotech.com
88	Rosseter Holdings	SW, MW	Cyprus	www.e-nanoscience.com
89	Samsung electronics	CNT	KOR	www.samsungelectronics.com
90	SELAH technologies	SW	SC	www.sealhtechnologies.com
91	Seldon laboratories	CNT	Vermont	www.seldontechnologies.com
92	SES research	SW, MW	TX	www.sesres.com
93	Shenzhen nanotechnologies	CNT	CHI	www.nanotubes.com.cn
94	Showa Denko	CNT	JPN	http://www.sdk.co.jp/html/english/index.html
95	Smart Nanomaterials	SWCNT	TX	http://www.smartnanomaterials.com/
96	Solarno	CNT	TX	www.solarno.com
97	SouthWest NanoTechnologies,	SW	OK	http://www.swnano.com/index.php
98	Stanford Materials	SW, MW	CA	http://www.stanfordmaterials.com/
99	Sun nano	SW, MW	CA	www.nanomaterialstore.com
100	Sun nanotech Co.	MW	CHI	www.sunnano.com
101	ST microelectronics	CNT	Swiss	www.st.com
102	Surrey nanosystem	CNT	UK	www.surreynanosystems.com
103	Teco Nanotech	MW	Taiwan	www.teconano.com.tw
104	Thomas-Swan	SW, MW	UK	www.thomas-swan.co.uk
105	Tokyo chemical industry	CNT	JPN	www.tci-asiapacific.com
106	Unidym, Inc	SW, MW	CA	http://www.unidym.com/
107	Vorbeck materials	CNT	MD	http://www.vorbeck.com/
108	Xintek	MW	NC	www.xintek.com
109	YTC america	CNT	CA	www.ytca.com/carbon_nanotubes
110	Zyvex	MW	TX	www.zyvexpro.com

-: information is not available

• Total: 110 companies

• US companies: 66, CA: 15
• Foreign companies: 54
• CNF: carbon nanofiber
• SW: single-walled
• MW: multi-walled

9.2.2 Quantum dots- Seznam proizvajalcev in njihova spletna stran

	Name	Products	Location	Web sites
1	American Elements	CdSe, CdTe, CdSe/ZnS	CA	www.americanelements.com
2	Antibody Incorporated	-	CA	www.antibodyinc.com
3	Evident Technologies	CdSe/ZnS, PbS	NY	www.evidenttech.com
4	Luna Nanoworks	Gd based QDs	VA	www.lunananoworks.com
5	MK Nano	CdSe, CdS, CdTe/CdS, CdTe	Canada	www.mknano.com
6	Nano Fluorescent Materials	CdGe/ZnS	Ukraine	www.nanofm.com
7	Nanoco Technology	CdSe, CdS	UK	www.nanocotechnologies.com
8	Nanosys	CdS, SiGe	CA	http://www.nanosysinc.com/
9	NN-Labs	CdSe/ZnS, CdS, CdSe	AR	www.nn-labs.com
10	Northern Nanotechnologies	CdTe/CdS	Canada	www.nntech.com
11	Ocean Nanotech	CdSe/ZnS, CdTe	AR	http://www.oceannanotech.com/
12	PlasmaChem	CdTe, ZnCdSe/ZnS	GER	www.plasmachem.de
13	Proteopure	-	PA	www.proteopure.com
14	QD Vision	-	MA	www.qdvision.com
15	SELAH Technologies	C based QDs	SC	www.selahtechnologies.com

• -: information is not available
• Total: 16 companies
• US companies: 11, CA: 3/11
• Foreign companies: 5

9.2.3. Fullerenes- Seznam proizvajalcev in njihova spletna stran

	Name	Location	Web sites
1	Alfa Aesar	MA	www.alfa.com
2	American Dye source	Canada	www.adsdyes.com
3	BuckyUSA	TX	http://buckyusa.com
4	Cheaptubes	VT	http://www.cheaptubesinc.com/
5	Frontier carbon corp.	JPN	www.f-carbon.com
6	Honjo chemical	JPN	www.honjo-chem.co.jp
7	Ionic liquid technologies	GER	www.nanomaterials.iolitec.de/index_e.htm
8	JenLaur Ltd.	NC	www.janlaurltd.com
9	Luna Nanoworks	VA	www.lunananoworks.com
10	Materials technologies research	UK	www.mtr-ltd.com
11	MER corporation	AZ	www.opus1.com/~mercorp/index.htm
12	Mitsubishi Chemicals	JPN	http://www.mitsubishichemical.com/
13	MK nano	Canada	www.mknano.com
14	MTR	OH	www.mtr-ltd.com
15	Nano NB	Canada	www.nanonb.com
16	Nano-C	MA	www.nano-c.com
17	PlasmaChem	GER	www.plasmachem.com
18	SES research	TX	www.sesres.com
19	Smart engineering tools	MI	www.smtools.com
20	Strem Chemicals	MA	http://www.strem.com/code/index.ghc
21	TDA research	CO	www.tda.com
22	Term USA	CA	www.fullerenesforsale.com
23	Tokyo chemical industry	JPN	www.tci-asiapacific.com

• Total: 23 companies
• US companies: 13, CA: 1
• Foreign companies: 10

9.2.4. Kovinski oksidi- Seznam proizvajalcev in njihova spletna stran

	Company name	Products	Location	Web sites
1	ABC Nanotech	SiO2	KOR	www.abcnanotech.com
2	Advanced Fibers & Powders	Al2O3	PA	www.afpllc.net
3	Advanced Nano Products Co	ZnO, ITO, Ag, TiO2	KOR	www.anapro.com/english/default.asp
4	ALD nanosolution	SiO2, Al2O3	CO	www.aldnanosolution.com
5	Alpha Environmental	TiO2, SiO2, Al2O3	CA	http://www.alpha-environmental.com/
6	AlphaNano technology	Fe2O3, SiO2	CHI	www.nanotubes.cn/index-en.htm
7	Altair nano	TiO2, ZnO	NV	www.altairnano.com
8	AMAG Pharmaceuticals	Iron oxide	MA	www.amagpharma.com
9	American elements	SiO2, ZnO, CeO2, WO3	CA	www.americanelements.com
10	Antaria	ZnO, CeO2	Australia	www.antaria.com
11	Applied nanotech	ZnO	TX	www.appliednanotech.net
12	ARRY international	MgO, CeO2, Al2O3	Hong Kong	www.arry-nano.com
	Avanzare Innovacion technologica	ZnO, TiO2, SiO, SiC, graphene	Spain	http://www.avanzare.es/
13	BASF	TiO2, ZnO, CeO2	GER	www.basf.com/group/corporate/en/innovations/e vents-presentations/nanotechnology/index /
	Buhler	TiO2, ZnO, Fe-oxide	Swiss	www.buhlergroup.com
14	China rare metal material	CeO2, Eu2O3	CHI	www.china-raremetal.com
15	DA nanomaterials	SiO2, Al2O3	AZ	www.nanosurry.com
16	DuPont	TiO2	TX	http://www2.dupont.com/Titanium_Technologies/en_US/
17	Enviroclean	TiO2	FL	http://www.teamenviroclean.com/home
18	EVOnik	ZnO, CeO2, ITO	GER	www.advancednanomaterials.com
19	Fuso chemical	SiO2	JPN	www.fusokk.co.jp/eng/index.html
20	Green millennium	TiO2	CA	www.greenmilleniuum.com
21	Green Nanolife	TiO2	CA	http://www.nanolifeusa.com/index.html
22	IBU Tec.	ZnO, Al2O3, SnO2	GER	www.ibu-tec.de
23	inframat	Cr2O3, ZrO2, Al2O3	NJ	www.inframat.com
24	Inframat Advanced Materials	Al2O3, TiO2, CeO2,	CT	www.advancedmaterials.us/index.htm
25	Ionic liquid technologies	Al2O3, SiO2	GER	www.nanomaterials.iolites.de/index_e.htm
26	Ishihara corp. USA	TiO2	CA	http://www20.inetba.com/ishiharacorpusa
27	Jiangsu Changtai Nanometer	TiO2	CHI	www.chinananometre.com.cn/eintro.htm
28	Keeling & Walker	SnO2	UK	www.keelingwalker.co.uk
29	Kemco International Asso.	Al2O3, CeO2, ZnO	FL	http://www.kemcointernational.com/
30	Kon Corp.	TiO2	JPN	www.saga-kon.co.jp/english/product.html
31	Konarka	Solar cell film	MA	http://www.konarkatech.com
	LEXON KOREA Corp.	SiO2, TiO2	KOR	www.lexonkorea.com/eng-site/index.jsp
32	Mach I, Inc.	Fe2O3	PA	www.machichemicals.com
33	Meliorum Technologies	CeO2, Al2O3, ZnO	NY	http://www.meliorum.com/
34	MicroTechNano	Al2O3	IN	http://www.microtechnano.com/
35	MK nano	Al2O3, ZnO, SiO2, TiO2, CeO2	Canada	www.mknano.com
36	MTI corporation	ZnO, CeO2, TiO2	CA	http://www.mtixtl.com/
37	NanoAmor	TiO2, Al2O3, SiO2, Fe2O	TX	www.nanoamor.com
38	Nanocerox	CeO2,	MI	http://www.nanocerox.com/
39	NanoChemonics	Iron oxide	VA	http://www.nanochemonics.com/
40	NanoCo	TiO2	KOR	www.nanoin.com
41	NanoE	Al2O3, ZrO2	FRA	www.nanoe.fr/index-vo.html
42	Nanogap	Fe2O3	Spain	www.nanogap.es
43	NANOMAG	CeO2	KOR	www.nanomag.co.kr/eng
44	Nanomaterials	Al2O3, CaTiO3, CeAlO3	PA	www.nanomateraislcompany.com
45	Nanomaterials Company	Al2TiO5	PA	http://www.nanomaterialscompany.com/
46	Nanomaterials research unit	ZnO, MgO	Thailand	http://physcis.science.cmu.ac.th/nano
47	Nano-Oxides	TiO2, CeO2, Fe2O3	UT	http://www.nano-oxides.com/
48	Nanophase Technologies	Al2O3, ZnO, CeO2, Fe2O3	IL	http://www.nanophase.com/
49	Nanopool	SiO2 spray coating	GER	www.nanopool.biz
51	NanoScale Corporation	CeO2, ZnO, TiO2	KS	http://www.nanoactive.com/
53	Nano-size Ltd.	SnO2, CuO	Israel	www.nano-size.com/index.htm
54	Nanux	TiO2	KOR	http://eng.nanocomposite.net
55	NEI corporation	CeO2, MgO, MgAl2O4	NJ	www.neicorporation.com
56	nGimat	CeO2, Fe2O3, MgAl2O4	GA	www.ngimat.com
57	NYACOL	CeO2, Y2O3, ZnO2	MA	www.nyacol.com

58	Oxitian	TiO2	FL	www.oxitian.com
59	Oxonica	TiO2, CeO2	CA	www.oxonica.com
60	PIDC	-	MI	http://www.pidc.com/
61	Pilkington	TiO2	CA	www.pilkington.com
62	PlasmaChem	Al2O3, TiO2, CeO2,	GER	www.plasmachem.de
63	Primet Precision Materials	TiO2	NY	http://www.primetprecision.com/
64	Qcells	Solar cell thin films	GER	http://www.qcells.de/en/solar_energy/index.ht ml/
65	Quantum sphere	Fe, Ag, Ni, Co, FeO, CuO	CA	http://www.qsinano.com/
66	Raymor nanotech	Al2O3, TiO2, Cr2O3	Canada	www.raymor-nanotech.com
67	Saint-Gobain	Al2O3, CeO2	CA	www.innovativeorganics.com
68	Sasol North America	Al2O3, Na2O	LA	www.sasoltechdata.com
69	Seashell tech.	SiO2, TiO2, SnO2	CA	http://www.seashelltech.com/
70	Shanghai Allrun Nano	TiO2, SiO2, ZnO	CHI	www.allrunnano.com
71	Shanghai Huzheng NanoTech	TiO2, SnO	CHI	www.hznano.com/en/index.asp
72	Showa Denko	TiO2, ZnO	JPN	http://www.sdk.co.jp/html/english/index.html
73	Silco International	SiO2	OR	http://www.silco-intl.com/contact.html
74	Simax technologies	SiO2	CA	www.simaxtech.com
75	Stanford Materials (Impoter)	MgO, Al2O3, TiO2	CA	http://www.stanfordmaterials.com/
76	Sukgyung	SiO2, MgO,ZrO2, Y2O3	KOR	www.sukgyung.com/index-en.htm
77	Sun nano	Y2O3:Eu, YVO4:Eu, ZnO	CA	www.nanomaterialstore.com
78	Tayka Corporation	TiO2, ZnO	JPN	http://www.tayca.co.jp/english/products/micro_ titanium/use_01.html
79	TiPE	TiO2	CHI	www.tipe.com.cn/index.htm
80	Turbo bead	Fe2O3	Swiss	www.turbobeads.com
81	TYR	Al2O3	CHI	www.rareearthoxide.com
82	Umicore Nanomaterials	TiO2, CeO2, ZnO	Belgium	www.nanograin.umicore.com
83	Very small particle company	Metal oxide	Australia	www.vspc.com

- -information is not available
- Total: 83 companies
- US companies: 45, CA: 13
- Foreign companies: 38

9.3 Seznam 534 nanotehnoloških podjetij po abecednem redu

Seznam 534 nanotehnoloških podjetij po *abecednem* *vrstnem redu* in s povezavami na njihovo spletno stran.

(Seznam je bil izdelan preko mreže Nanotechnology Now,pri iskanju proizvajalcev nano delcev)

21st Century NanoTechnologies
Single-walled carbon nanotubes (SWNT)

3DM Inc.
"PuraMatrix™, 3DM's innovative and award-winning family of biocompatible hydrogels ... nano-scale properties, synthetic origin, rigorously-tested biocompatability, stability and ease-of-use yield superior cell cultures, with applications in drug discovery, cancer and cell biology, toxicity screening, stem cell therapeutics and tissue engineering."

3rdTech
Maker of the NanoManipulator

A123 Systems
"... developer of a new generation of Lithium-Ion batteries that revolutionizes the way manufacturers design high power products. Founded in 2001, A123Systems' proprietary nanoscale electrode technology is built on initial developments from Massachusetts Institute of Technology."

A&A Company
"Thermal spray coatings and nano thermal spray coating using custom designed metal, ceramic, cermet and hard faced materials."

Ablynx
"... a biopharmaceutical company engaged in the discovery and development of Nanobodies™ to treat a range of serious human diseases. Nanobodies™ are a novel class of antibody-derived therapeutic proteins."

Abraxis Oncology
"The proprietary drug division of American Pharmaceutical Partners. ... dedicated to improving treatments for patients with cancer." Maker of Abraxane - paclitaxel protein-bound nano-particles for injectable suspension.

Abtech Scientific
"... a biomedical diagnostics company that delivers biosensor devices, biosensor instruments and biosensor systems to the biomedical research community and the point of concern biomedical diagnostics market."

AccuFLEX Golf Company
NanoShaft

Acrongenomics
"... a publicly traded Nanobiotechnology company that specializes in the field of research and

development of solutions in the fields of Genomics, Proteomics and Diagnostics."

AcryMed
"... a development and manufacturing company focused on the introduction of novel medical products that help heal wounds or reduce infections."

Actel Corp.
"... award winning single-chip FPGA solutions, including FPGAs based on antifuse and Flash technologies, high-performance intellectual property (IP) cores, integrated software development tools, programming tools, debug and demo boards, and design services."

Active Optical Networks
"... advanced MEMS-based active optical components and subsystems to enhance the performance and wavelength management capabilities of optical networks."

Admatechs
"Spherical shape particulates. Admatechs is a joint venture of Toyota Motor Corp., Shin-Etsu Chemical Co., Ltd., Shin-Etsu Quartz Products Co., Ltd., and other firms."

Advance Nanotech
"Operating in three areas, electronics, biopharma and materials, Advance leverages relationships with financial and development resources to enable a product focused, fast-track commercialization of nanotechnology."

Advanced Battery Technologies
"... develops, manufactures and distributes rechargeable polymer lithium-ion (PLI) batteries"

Advanced Fibers & Powders
Technology development and advanced material manufacturing.

Advanced Diamond Technologies
(ADT) "An early-stage company commercializing a patented technique for making thin films of nanocrystalline diamond. This novel material, which we call Ultrananocrystalline diamond (UNCD), is a form of natural diamond—not a diamond-like compound. UNCD possesses the material properties of natural diamond in thin film form."

Advanced Magnetics
"... a developer of superparamagnetic iron oxide nanoparticles used in pharmaceutical products."

Advanced Micro Devices
Microprocessor Solutions

Advanced Nano Coatings
"... a producer of high performance, VOC compliant epoxy coatings."

Advanced Nano Products
(ANP) Manufactures nanocrystalline materials and their chemical precursors for coating and powder processing applications.

Advanced Nano Technologies
(ANT) Manufactures of a wide range of ultra fine and nanoscale powders.

Advanced Nanotechnology Limited (Advanced Nano)
Manufactures a range of nanopowders and functional products that incorporate nanopowders.

Advanced Powders & Coatings (AP&C)
Wholly-owned by Raymor Industries Inc. "... spherical metal powders."

Advanced Sensor Technologies
"... developing and bringing to market a variety of miniature, sensor-based biotechnology devices for research and medical applications."

Advion BioSciences
"... bioanalytical services and nanoelectrospray products."

Advectus Life Sciences"... an emerging life sciences company focused on the commercialization of a cure for brain cancer. Advectus holds the exclusive worldwide rights including patents to this nanoparticle-based technology for the delivery of approved cancer fighting drugs across the blood-brain barrier for the treatment of brain tumors."

Aegis Semiconductor
"... wavelength-monitoring components and modules that are easily manufactured using proven methods from the semiconductor industry."

Affymetrix
GeneChip(R) technology has become the industry standard in molecular biology research.

Agendia
"... developed high-quality methods, using micro-array genetic profiling, for analyzing tumor samples and mapping the tumor’s specific properties."

Agere Systems
(Formerly the Microelectronics division of Lucent Technologies) The "world leader in sales of communications components. We design, develop and manufacture optoelectronic components for communications networks, and integrated circuits for use in a broad range of communications and computer equipment."

Agilent
"Agilent Technologies is on the leading edge of nearly every major trend in communications and life sciences. From optical and wireless communications to disease and discovery research, Agilent delivers product and technology innovations that benefit millions of people around the world."

Ahwahnee
"... a leader in the mass production of Carbon Nanotubes (CNTs), creates high-energy, long-lasting and cost-effective CNT applications for a variety of industries."

Air Products and Chemicals
"... atmospheric gases, process and specialty gases, performance materials and chemical

intermediates."

Aktina Limited
"Nano-engineered films for creating stable surface structures."

Akzo Nobel
Coatings/Chemicals and Pharmaceuticals

AlCove Surfaces
Medical device technology using special designed ceramic surfaces made of nanoporous aluminium oxide, applications such as local drug delivery or local brachytherapy. And nanostructured surfaces between 20 nm and 300 nm, changing the reflectivity, adhesion, wettability, and other properties.

ALD NanoSolutions
"... commercialization strategy is founded on the assertion that new materials will be designed rather than discovered. The compelling opportunity is to identify and synthesize a new set of composite materials which are comprised of common substrates coated with specific material."

Alien Technology "... has developed, and holds exclusive patent rights to, a manufacturing technology that will dramatically reduce the manufacturing cost of a variety of electronic devices. The technology, called Fluidic Self-Assembly (FSA™), permits the efficient assembly of Integrated Circuits into a variety of substrates, from glass to flexible plastic."

Allegro Technologies
"... is a knowledge-based campus company. It has developed outstanding proprietary microdispensing technologies for current and next generation applications in the fields of drug discovery, genomics and analytical/diagnostic instrumentation."

Allomet Corporation
Powered Metals

Almatis
Specialty Alumina Materials

Alnair Labs
"... established on 29th August 2001 with the aim to provide ultra-short pulse laser systems and solutions based on its unique carbon-nanotubes photonic technology."

Alnis BioSciences
"... a drug development company with a potent, enabling therapeutic platform to treat cancer as well as infectious and inflammatory diseases. Alnis has engineered nanoscopic hydrogels, or NanoGels, comprised of polymers, bioactives, and targeting molecules."

Altair Nanomaterials A wholly-owned subsidiary of Altair Nanotechnologies Inc. Altair owns a proprietary technology for making nanocrystalline materials of unique quality, economically and in large quantities. The company produces closely-sized nanoparticles of titanium dioxide and related ceramic oxide materials and compounds.

Ambri Biosensor Technology
"... pioneering the integration of Biotechnology, Nanotechnology and Electronics."

AMBIT Corporation
"... developer of new and enabling technologies in a variety of fields where rapid commercialization is taking place."

American Elements
"... a world leader in commercializing developments in materials science."

American Dye Source
"... is now offering nano materials. These materials can be used for a variety of applications in display devices, security devices and heat reflecting devices."

American Superconductor
"... supplier of dynamic reactive power grid stabilization products and the world's principal vendor of high temperature superconductor (HTS) wire and large rotating superconductor machinery."

AMICA
Advanced Micro-electronic Center Aachen "Our research is dedicated to silicon process technology with a strong focus on nanolithography."

AMR Technologies
"... develops, manufactures and distributes performance materials."

Amroy
"Our latest product family is HybtoniteŽ-nanoepoxies. HybtonitesŽ can be used in marine, automotive, wind energy and in many industrial applications."

AMT Coatings
"A technological based SME industry which deals with engineering coatings and advanced surface treatments for production of nanomaterials coatings (Electroplating, Electroless Plating, Anodising, PVD, etc.)."

Angstrom Medica
"... a life-sciences biomaterials company that harnesses nanotechnology for orthopedic applications."

ANP Technologies

"... develop cutting-edge technology platforms at the nano/bio interface and apply them in market sectors such as diagnostics/biodetection, protein/drug discovery, therapeutics, chem/bio defense, and homeland security."

Aonex Technologies
A subsidiary of Arrowhead Research. "... focused on applying its technology to next-generation solar cells. Ultimately, the company seeks to enable devices with optical, logical, and amplification features on a single substrate."

AP Materials
"Nanopowders and Nanotechnology for Advanced Materials."

ApNano Materials "... commercializes nanospheres and nanotubes of inorganic compounds discovered at the Weizmann Institute of Science in Rehovot, Israel. These materials are used in microelectronic, semiconductor, aerospace, lubricant and metal working markets." See funding article for more information.

Applied Materials
"... supplier of products and services to the global semiconductor industry."

Applied Membranes
"... a manufacturer and distributor for Reverse Osmosis Membranes, RO Systems and Components, both commercial and residential."

Applied MicroStructures
Surface chemistry and modification.

Applied Nanotech
A subsidiary of Nano-Proprietary, Inc. "Currently ANI is in advanced development for the application of electron emitting carbon nanotubes cathodes in a number of areas, including large area color televisions, new lighting devices, x-ray, and microwave generators."

Applied Sciences, Inc.
(ASI) "a nationally recognized Research and Development company specializing in advanced materials and their applications. ASI is located near Dayton, Ohio, and consists of three additional affiliate companies, PyrografŽ Products, Inc. (PPI), Nano Graphite Materials (NGM), and Aqua Locator."

Applied Thin Films
(ATFI) "An advanced materials company developing thin film technologies to serve defense, energy, aerospace, and other industrial needs."

AQUANOVA German Solubilisate Technologies GmbH
"As a scientifically orientated company AQUANOVA specialises in the development and production of clear, stable, water-free solubilisates of particles with a micelle structure for further

processing in cosmetics, skin care products, pharmaceuticals, foodstuffs and nutritional supplements."

Arc Flash Corporation
Photocatalyst coating material

Argonide
A resource manufacturer for high purity nanoparticles, nanoscale ceramic fiber materials, and custom alloys.

Asahi Glass Co.
A global materials and components supplier.

Asemblon
"... specializing in the emerging field of self-assembling molecules or SAMs."

Asia Pacific Fuel Cell Technologies
"... PEM fuel cells with technologies in stack design and manufacture, system integration and metal hydride hydrogen storage."

Asklepios BioPharmaceutical
"... a biotechnology company engaged in the development and delivery of novel protein and cellular based therapies through design of proprietary Biological Nano Particles (“BNP”)."

Aspen Aerogels
"Using patented technology, Spaceloft and Pyrogel materials combine a silica aerogel with reinforcing fibers to deliver proven thermal performance in the most efficient insulation available."

Atlas Mining
"Halloysite is a high-value clay that sells for more than $400 per ton. Its fine particle size enables halloysite to be used extensively as a suspension agent in glaze preparations. The purity of the clay and the low iron and titania content result in ceramic ware with exceptional whiteness and translucency."

Authentix
"Formed by the merger of Isotag, Biocode and Calyx in 2003, Authentix combines 20 years experience in providing comprehensive services and technology for the prevention of product counterfeiting, brand adulteration and product diversion."

BASF
BASF is one of the world leaders in the chemical industry, and currently produces several nano-products, such as nanoparticle pigments and nanoscale titanium dioxide particles. See also Nanotechnology at BASF

Baytubes
"As a market- and customer-oriented inventor company, Bayer MaterialScience is working closely with Bayer Technology Services to promote the development of this exciting future technology

(nanotubes)."

Beijing Nano Sunshine Technology Co. Ltd
Nanocor's regional distributor in China

Bell Labs

BioCrystal
"... semiconductor-based, nanocrystalline fluorescent markers for cell and intracellular detection and analysis; therapeutic compounds and procedures for the diagnosis and treatment of cancer; and the very innovative OptiCell Ž, a product that represents a significant step forward in the evolution of cell and tissue culture technology."

BioForce Nanosciences
"... developer of ultra-miniaturized nanoarray technologies for solid-phase, high-throughput biomolecular analysis."

Biophan Technologies
"Biophan is developing technology to make biomedical devices safe, both implanted devices and those used in surgical and diagnostic procedures, and to reduce interference that these devices cause to Magnetic Resonance Imaging (MRI) image quality."

BioTrove
"A privately held biotechnology company focused on leveraging revolutionary micro- and nano-scale engineering solutions that improve the efficiency and productivity of drug discovery."

Blue Pacific
"... a leader in new flavor technology."

Bonderite NT
Nanoceramic Technology

Bourne Research
"... market intelligence, with a specialized focus on MEMS (MicroElectroMechanical Systems), Nanotechnology, and the convergence of both."

Brewer Science - Specialty Materials Division
"Provides novel polymers and resins for use in MEMS device applications, Image Sensors and Flat Panel Displays."

BuckyUSA
Specialty manufacturer of carbon nanomaterials.

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C Sixty
"... a private biopharmaceutical company focusing on the discovery and the development of a new

class of therapeutics based on the fullerene molecule ..."

Cabot Corporation
"... our core businesses: carbon black, fumed metal oxides and tantalum. We've also found and developed them into new businesses: inkjet colorants, NanogelŽ and specialty fluids."

California Molecular Electronics Corporation
"... committed to profitably invent, acquire, assimilate, and utilize intellectual property in the field of molecular electronics to develop and sell quality products based on molecular electronics technology ..."

Cambrios Technologies
"... mission is to use biological technology to transform the way commercial electronic products are made, expand their impact, and reduce their environmental cost. Cambrios was formed in 2003 to develop commercial applications from the directed-evolution technology invented by the company’s founders, Dr. Angela Belcher of MIT and her longtime collaborator, Dr. Evelyn Hu of the University of California at Santa Barbara."

Canano Technologies
"We specialize in the mass production of pure nanometals, and to date have produced aluminum, copper, iron, cobalt, indium, selenium, tungsten and copper/gallium."

CAP-XX
"... develops supercapacitors - high-power, high-energy storage devices that enable manufacturers to make smaller, thinner and longer-running products such as mobile phones, PDAs, medical devices, AMRs, compact flash cards, and more." Locations worldwide.

Capsulution NanoScience AG
"... is a Berlin-based company, which has started with a vision: to create innovative, highly-specialized products by applying its unique LBL-TechnologyŽ to existing and emerging needs in life science developments. The LBL-TechnologyŽ (derived from the term "layer-by-layer") is a high-tech tool for making unique multifunctional nano- and micron-sized capsules which are invisible to the human eye."

CarboLex
Manufacturers of single-walled carbon nanotubes (SWNT).

Carbon Designs, Inc. (CDI)
"... producing CNTs, CNT-based carbon fibers, and CNT Composites with superior mechanical properties."

Carbon Nanotechnologies, Inc.
"The Leader in Carbon Nanotechnology and Single-wall Carbon Nanotube Production"

Carbon Nanotech Research Institute
(CNRI) A subsidiary of Mitsui & Co. Research and development of fullerenes and carbon nanotubes which are applicable to next-generation semiconductor, fuel cells, drug remedies for

H.I.V., and industrial mass production technology of these materials. About CNRI

Carbon Solutions Inc.
(CSI) Carbon Solutions Inc. is involved in the chemistry, applications and commercialization of single-walled carbon nanotubes (SWNT).

Catalytic Materials LLC
"... was incorporated in 1995. Leaders on the architecture and design of carbon nanostructured materials including graphite nanofibers and carbon nanotubes."

Catalytic Solutions
"... manufactures and delivers a break-through proprietary technology that significantly improves the performance and reduces the cost of catalytic converters."

Cavendish Kinetics
"... focuses on the development of CMOS compatible MEMS process modules, the design and modeling of MEMS devices and subsequently providing these two combined (process module and design module) as an IP (Intellectual Property) package for customers to use in numerous different application areas."

Cereplast
"... the developer and manufacturer of a breakthrough new material which is used as a substitute for conventional, petroleum-based plastics."

Center for Automation in Nanobiotech (CAN)
"... focuses on investigation of new paradigms for innovation in systems and automation design. CAN's main thrust and aim is the development of practical and useful nanobiotechnology systems and devices that may benefit people around the globe with biomedical engineering advances."

Centre for Large Space Structures and Systems (CLS3 Inc.)
"... technologies for large space structures towards the micro devices and systems of the future."

Ceramatec
"... nano-powders for targeted applications like infrared windows, catalysts, fuel cells, and even cosmetics."

cDream Corporation (“cDream”)
"... is a fabless display company, founded to develop and design the next evolution of flat panel displays (“FPDs”) using our proprietary carbon-nano tube technology, replacing and superceding displays based on cathode ray tube (“CRTs”), thin film transistor liquid crystal (“TFT-LCDs”), plasma display panels (“PDPs”) and organic light emitting diodes (“OLEDs”)."

CFOAM
"Developed by Touchstone Research Laboratory, Ltd., CFOAM is a cost-effective, next-generation carbon foam structural material."

Chartered Semiconductor Manufacturing

Dedicated semiconductor foundry.

Cheap Tubes
"... committed to supplying the nanotechnology research and industrial community with the highest quality carbon nanotubes (CNTs) at the lowest prices."

Chemat Technology
"... has established itself as a world leader in the development of advanced materials via sol-gel technologies."

Chengyin Technology
Focused on the R&D of nano-structured titanium dioxide in sunscreen, antimicrobial, anti-static and photocatalysis

Cima NanoTech
" ... is an advanced materials company specializing in the production of nanoscale conductive dispersions for the electronics industry."

Clean Technology International Corp.
"... is committed to producing Nanocarbon materials."

Climax Molybdenum
A subsidiary of Phelps Dodge Corporation. Engineered Materials.

CLS3 Inc., MEMS for Aerospace
"... information and details related to research and development of MEMS technologies for aerospace applications in Canada ..."

CMP Científica
Europe's first integrated solutions provider for the Nanotechnology Community, specialising in providing Nanotechnology information to the scientific and financial communities; Linking science & industry through networks of excellence and conferences; Providing expert solutions for high technology and advanced manufacturing companies; Venture Capital funding for nanotechnology startups.

Colibrys
"...supplier of Micro Electro-Mechanical Systems (MEMS) and components, Micro Optical Electro-Mechanical Systems (MOEMS) and Micro optical components."

Colossal Storage Corp.
Developing a rewritable volume holographic optical mass data nanophotonic storage device.

Cool Chips
"... is the future of all cooling, refrigeration, and thermal management. Cool Chips use a revolutionary new thermotunnel technology to deliver up to a projected 70-80% of the maximum (Carnot) theoretical efficiency for heat pumps."

Copernicus Therapeutics
"... a privately-held company developing products for human gene therapy and vaccination."

Corning IntelliSense
MEMS design, development, manufacturing and CAD for MEMS software for telecommunications, life sciences and microinstrumentation. A subsidiary of Corning

Coventor
(Formerly Microcosm Technologies, Inc.,) "... a product development company that continually transforms forward-thinking ideas into innovative communications and biotechnology products made possible by MEMS".

Crystalplex Corporation
"... develops tools to decode the complexity of today's problems in drug discovery and clinical diagnosis. With proprietary reagent technology based on nanocrystal-encoded microbeads, Crystalplex provides the means to interpret vast amounts of information."

CSIRO NanoScience Network. CSIRO is Australia's Commonwealth Scientific and Industrial Research Organisation. The NanoScience Network provides a focal point for CSIRO’s nanotechnology activities.

Cymbet Corporation
(Cymbet) "...will be the first to market with a true solid state rechargeable battery (licensed technology) using a proprietary, patent pending manufacturing process. This Cymbet technology will enable new concepts in battery applications for IC's and new applications for handheld computer, communication, medical, sensor, and portable electronic devices. ... Oak Ridge National Labs brought the materials science, Cymbet brings the process science."

Cyrium Technologies
"... developing high-efficiency solar cells, using proprietary breakthrough technology, for the space and terrestrial markets."

CytImmune
"... is developing a pipeline of multifunctional, next-generation therapeutics, binding known anti-cancer agents – whose toxicities currently prevent or severely limit clinical use – to its patented colloidal gold tumor-targeting nanotechnology."

Cytoplex BioSciences
"Cytoplex offers nanotechnology solutions that provide high levels of information content about cell-drug interactions. Cytoplex’s technology simplifies “ion channel” screening, which is key to researching central nervous system, cardiovascular, and other diseases."

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Dais Analytic Corporation
"... a nanotechnology polymer materials company. We design and commercialize new materials that exceed the limits of conventional materials."

DayStar Technologies
"DayStar strives to build a world of “Pervasive Solar Energy” to power every corner of the planet with photovoltaic products that remove materials and manufacturing barriers currently limiting widespread use."

Degussa Advanced Nanomaterials
An internal start-up of Degussa - making nanoscaled powders.

Dendritech
"... licensed by The Dow Chemical Company to manufacture and sell ethylenediamine-core poly (amidoamine) (PAMAM) dendrimers and other specialty dendrimers."

Dendritic Nanotechnologies Limited
A joint venture of chemist Donald Tomalia and Melbourne, Australia-based Starpharma Pooled Development Ltd.

DFI
"DFI’s nanotechnology is applicable to most surfaces containing silica (silicon dioxide) such as glass, ceramic tile, porcelain, and granite."

Diamond Materials
"Functionally Graded Nanophase Beryllium/Carbon Composites."

Discera
Using technology developed by Dr. Clark T.-C. Nguyen, the University of Michigan and the University of California at Berkeley, Discera replaces the passive (and some active) components on a wireless circuit board with a single micromechanical system that offers exceptional reception quality. A member of the Ardesta family of companies.

Docoop Technologies
"*Neowater*™, a novel proprietary water-based nanotechnology, is a broad enabling platform upon which research, diagnostics, biotech and pharma companies can obtain disruptive price-performance results, yet with a graceful implementation."

DSM Somos
Rapid prototyping materials, incorporating ceramic nano-particles.

DuPont Air Products Nanomaterials
A joint venture between DuPont and Air Products and Chemicals, Inc. "Developing, manufacturing, marketing and selling polishing slurries for electronic precision polishing and chemical mechanical planarization (CMP) processes used in the semiconductor industry.

DuPont Titanium Technologies
" ... dedicated to creating greater, more rewarding value for the coatings, paper, plastics, specialties and minerals markets through service, brand, and product."

Dyesol

"To Industrialise and Commercialise Dye Solar Cell Technology."

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E47 Technologies
Advanced textile technologies.

Eastman
"... the largest producer of polyester plastics for packaging and is a leading supplier of raw materials for paints and coatings, inks, and graphic arts, adhesives, textile sizes and other formulated products, and of cellulose acetate fibers."

Ecology Coatings
"... focus on the development of nano-engineered, liquid 100% solids, ultra-violet curable industrial coatings."

EcoSynthetix
"... is a clean technology company, positioned to replace petroleum-based industrial products with nanobiomaterials."

ec systems
"... assists companies in identifying products where carbon nanotechnology offers a clear path to improved performance. We perform complete feasability assessments, work with your team to formulate a development proposal and aid in the execution of the plan from pilot production through scale-up to commercial production." Also supplies nanotubes and related graphitic nanostructures."

Eikos
"develops unique Carbon Nanotube Formulations for Coatings. We also develop coating methods that allow the conversion of those formulations into highly differentiated products for the commercial displays market and for a wide range of military applications."

Elan Drug Delivery
"Our mission will continue to be the provision of drug delivery platforms for new molecules—insoluble compounds, genes, proteins and peptides—that need to be delivery-engineered right from the discovery stage." Drug Delivery Technology NanoCrystalŽ Technology.

eMembrane
"The Company's proprietary platform technology is nano-grafting of combinatorial polymer brushes."

Emergency Filtration Products
"... formed to develop a preeminent filtration technology that would serve to ensure the safety of rescuers by virtually eliminating risk of cross-contamination during CPR."

Enable IPC
"... engaged in the development of a new battery technology that combines the best of thin films and

nanotechnology."

Engelhard
"Fundamentally, we manipulate basic materials - typically minerals - to alter their structure and surface characteristics. We manipulate them mechanically and chemically, altering their size, shape, porosity and chemical characteristics to produce a wide range of functionality with important business uses."

engeneOS
"... will carry out technology and product development to design and build programmable Biomolecular Devices consisting of hybrid natural/non-natural materials addressing a broad range of commercial applications."

EnviroSystems
"... products include a line of hospital-grade cleansing and disinfecting liquids and wipes that reduce the spread of infectious disease without adverse effects to people, equipment or the environment."

eSpin Technologies
"... polymeric nanofiber manufacturing technology applicable across the universe of emergent and traditional manufacturing sectors."

Evident Technologies "... is a nanotechnology manufacturing and application company that draws upon semiconductor nanocrystal expertise to develop sophisticated, cost effective, innovative devices and products."

Evolved Nanomaterial Sciences
"... an advanced materials company dedicated to the discovery, fabrication and integration of biopolymers into a variety of high-margin applications."

Filtration Technology
Filtration, Cleanrooms, and Contamination Control

Five Star Technologies
"... an advanced materials company specializing in the design and manufacture of engineered materials and dispersions."

Flamel Technologies
"... a recognized world leader in the innovation of delivery systems for small molecule and protein drugs, providing tailored solutions to the biotech and pharmaceutical industries for optimized controlled-release delivery of drugs."

Fluidigm
"... provides a unique solution through fluidics at the nano-scale, using palm-sized devices with integrated channels and valves."

Focal Point Microsystems

FP Micro is currently developing a state-of-the-art, free-form fabrication system for 3D objects that utilizes proprietary patterning materials. This integrated bench-top unit will be convenient, user-friendly, environmentally friendly, and capable of prototyping and producing 3D micro and nanoscale structures, components, and devices.

Foster Corporation
Specialty thermoplastic compounding materials and polymers.

Fractal Robot Digital Matter Control

Frontier Carbon Corporation
Mitsubishi Corporation and Mitsubishi Chemical Corporation said they will make fullerenes available in quantity beginning in early 2002 under a new joint venture to be known as Frontier Carbon Corporation. Mass production, anticipated to reach 1,500 tons a year by 2004, will permit fullerenes to be bought at prices 10 to 100 times lower than those currently prevailing.

Fullerene International Corporation (FIC)
"... combines the capabilities of partners Mitsubishi Corporation (MC), Materials and Electrochemical Research Corporation (MER), and Research Corporation Technologies (RCT) in a joint venture to commercialize fullerene materials."

GE Advanced Materials
"... a world leader in providing material solutions through engineering thermoplastics, silicon-based products and technology platforms, and fused quartz and ceramics."

GEMZ Corp.
"GEMZ Corp. recently incorporated its wholly-owned subsidiary, International Nanotechnology Corp. The Company has as its goal to Develop patented, commercial products using Nanotechnology to harness renewable energy."

GeneFluidics
"... a bionanotechnology company founded in November 2000 by leading scientists and researchers from UCLA. The Company has developed a technology platform capable of making highly manufacturable, cutting-edge electrochemical molecular analysis devices using integrated nanotechnology, plastic micro electromechanical systems (MEMS) and microfluidics."

General Nanotechnology
(GN) "... hardware and software that provides advanced capabilities in imaging, nano-manipulation, nano-fabrication, nano-spectro-photometry, near field optical probes below the aperture (50nm) limit, and diamond and other nano-tools and parts."

Gennum
"... a Canadian high technology company that designs, manufactures and markets silicon integrated circuits (ICs), modules and thin-film hybrid microcircuit components for a variety of applications in three target markets."

GEO-CENTERS

"GEO-CENTERS supports the U.S. Naval Research Laboratory (NRL) in developing nanoscience and integrating nanotechnology into usable systems."

Genesis Nanotech Corporation
"... produces Nano-scale AlOOH,TiO2 & other ceramic powders and slurries for polishing , coating , & photo-catalyst high-tech industries."

Genthe -X- Coatings
"... develops, manufactures and applies nano-coatings to optical substrates enabling transparency even under the toughest conditions - a truly transparent performance."

Greenmillennium
"... a photo-catalyst material and solution provider in the domain of environmental coating services and business integration."

Groupe Minutia
Specializing in nanometric powder technology.

HelioVolt
"... has developed the fastest and most effective way to manufacture CIS (Copper Indium Selenide), the most reliable and best-performing thin film material for generating electricity from sunlight."

Helix Material Solutions
"... a nanotechnology company based in Texas and founded by a group of world-class experts and scientists in nanoscience and nanotechnology, who are devoted in bringing the best nanoscale materials to the market at affordable prices."

Henkel
"We have only just begun to uncover the vast possibilities of this fascinating field (nanotechnology). The first interesting products have been developed, from additives in cosmetics to barrier effects in adhesives, and lubricants for process chemicals."

Hewlett-Packard

HP Labs - Quantum Science Research

Hitachi High-Technologies
"... established on October 1, 2001. The new company combines the global sales force of the high-tech trading company Nissei Sangyo Co., Ltd., with the world-class technological capabilities of the Instruments Group and the Semiconductor Manufacturing Equipment Group of Hitachi, Ltd."

Holographix
"... state-of-the-art recording, replication, testing, and thin-film coating laboratories."

Hybrid Plastics
"... manufactures nanostructured chemicals for the preparation of nanocomposite materials. Polyhedral Oligomeric Silsesquioxane (POSS) is a silicon based material that is intermediate in

composition between silica and silicone."

Hyosung Group
Textile and industrial materials manufacturer, and "maker of nano fiber for health-minded wearers."

Hyperion Catalysis International
Carbon nanotube development and commercialization.

IBM Research
Nanoscale science department

IBM Almaden Visualization Lab

IBM Zurich
The Industry Solutions Lab (ISL) is a joint effort between IBM Research and IBM's Global Industries marketing organization.

iCurie Lab Holdings
"... research, development and commercialization of advanced microfluidic and nanofluidic technologies for use in nanoelectric machines and micro electromechanical (MEMS) systems."

ILJIN Nanotech
CNT producer

Illuminex Corporation
"... dedicated to engineering advanced nanowire device technology."

ImaRx Therapeutics
"We believe that localized, site-specific, NanoInvasive™ medicine will provide benefit to patients and society by lowering costs, minimizing pain, and reducing the length of hospital stays and recovery time, while providing improved patient outcomes."

Industrial NanoTech
"... funds & participates in reseach with the world's brightest scientists and leading laboratories."
Makers of Nansulate™ nanocomposite insulation.

Industrial Science and Technology Network
ISTN is a materials research company specializing in the development and commercialization of nanotechnology products for industrial applications. ISTN business plan focuses on three broad areas where it believes its core scientific competencies will be able to have a significant commercial impact - traditional industrial products, optical electronics and biotechnology.

Inframat
"An emerging technology company with a mission to develop a variety of materials to improve performance and extend the life of components used throughout the global infrastructure."

Inmat

"InMat’s proprietary nanocomposite technology provides customers with gas, vapor, and chemical barrier coatings that are thinner, lower cost, and more environmentally friendly than alternative barrier materials."

InnovaLight
"developing solid-state lighting solutions based on its luminescent silicon nanocrystals."

InPhase Technologies
"... next generation in data storage that stores millions of pages of information on a disk that fits in the palm of your hand."

INPT
Institut National Polytechnique de Toulouse. "We supply, in collaboration with an industrial group, samples of MWNT (10-100g)."

Insert Therapeutics
A subsidiary of Arrowhead Research. "... expanding the frontiers of drug delivery technology. In contrast to existing, FDA-approved methods, the proprietary technologies of Insert Therapeutics provide for the intracellular delivery of a broad range of therapeutics."

Institute for Microstructural Sciences
"... to provide leadership, in collaboration with Canadian industry and universities, in the development of the strategic base for information technology."

Institute of Bioengineering and Nanotechnology (IBN)
"... established to spearhead the advancement of biomedical sciences in Singapore."

Integran Technologies
Nanostructured material technologies.

Integrated Nano-Technologies
"... developing ground-breaking products around a revolutionary approach for physically coupling molecular biology and microelectronics."

Intel
"Intel supplies the computing and communications industries with chips, boards, systems, and software building blocks that are the "ingredients" of computers, servers and networking and communications products." "Intel is behind everything from the fastest processor in the world to the cables that power high-speed Internet."

Intelligent MEMS Design
Primarily focused on MEMS, they also "project market demands, trends and forecasts based on current and potential future global markets for nanotechnology, and provide patent and IP related services."

Intematix
"Intematix methodology for Materials Discovery utilizes the latest in top-down design and rapid

prototyping."

Interface Sciences Corporation
"... commercialization of the extraordinary patented SAMs technology."

Introgen Therapeutics
"... a biopharmaceutical company focused on the discovery, development and commercialization of molecular therapies for the treatment of cancer and other serious diseases."

Invest Technologies
"Our enterprise takes part in the activity of Russian Committee “Ultrafine (nano) materials” for production, research of properties and application of UFP. We also cooperate with leading scientific institutes, conducting studies of nanocrystal materials."

Isonics
Advanced materials

Isotron
"... advanced coatings, polymers and materials for high-performance industrial, military and civil transportation applications."

it4ip
"... spin out from the Université Catholique de Louvain (Belgium), dedicated to the development and production of unique templates based on the combination of ion track technology of polymers with templating capabilities."

ItN Nanovation
"... main focus on the development, production and commercialisation of products based on nanotechnology."

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JMAR
"... develops, manufactures and markets a wide range of precision measurement, process control and laser manufacturing systems to enable its customers to produce smaller, faster, more powerful and less expensive precision microelectronic products. JMAR also provides custom semiconductor products and is a leading developer of advanced lithography sources for the production of higher performance circuits for future electronic systems."

JR Nanotech
"... a healthcare company which promotes the application of nano-silver. We use nano-silver particles as an antibacterial substance to provide effective and complication free treatment for age old healthcare."

Kainos Energy Corporation
"... has adapted revolutionary nanomaterials processing technologies to fuel cell manufacturing to achieve: lowest cost, lower operating temperature, highest performance and reliability in solid oxide

fuel cells, interconnects and stacks."

Kelvin Nanotechnology
" ... created in 1997 to facilitate the commercialisation of the world-class technology and expertise in the Department of Electronics and Electrical Engineering at the University of Glasgow."

Kerdry
Thin films technologies and optical components coatings.

Kereos
"... develops targeted therapeutics and molecular imaging agents that detect and attack cancer and cardiovascular disease earlier and more specifically than previously possible."

Keweenaw Nanoscience Center
(KNC) "Our mission is to develop low cost, abundant, clean, alternative energy, using nanotechnology, to produce highly efficient solar cells, fuel cells and fusion energy technologies."

Keystone Nano
"... seeks to improve human health by creating new ways to diagnose and treat human diseases and improve the quality of life. Keystone Nano partners with healthcare companies to complete the development and speed the market launch of nano-enabled therapeutics to seek/treat/image a variety of conditions."

Knowmtech
"... based in Santa Fe, New Mexico, is an intellectual property development and holding company that is currently developing a patent portfolio centered around nanotechnology-based neural networks, including neural network semiconductor chips and related devices and fabrication processes."

Koch Membrane Systems
"As advances in nanofiltration (NF) continue to stream into the global marketplace, Koch Membrane Systems continues to maintain its established role as the prime innovator."

Komag
"... supplier of thin-film disks, the primary high-capacity storage medium for digital data in computers and consumer appliances."

Konarka technologies
Konarka Technologies "... is dedicated to the development and commercialization of solutions for portable and distributed power needs based on photovoltaic products... ... The core of the dye-sensitized technology consists of *nanometer-scale crystals* of TiO2 semiconductor coated with a monolayer of light-absorbing dye and embedded in an electrolyte between the front and back electrical contacts."

Kopin
"... patented Wafer-Engineering™ technology in which nanotechnology is applied to semiconductor materials."

Labein
Centre for Nanomaterials Applications in Construction (NANOC) "... a recently created unit with in LABEIN and a platform aimed at developing key technological capacities that will enable the Construction Industry to use Nanotechnology as a competitive tool."

Labopharm
"... international, specialty pharmaceutical company focused on improving existing drugs by incorporating our proprietary, advanced controlled-release technologies. ... also developing novel polymeric, nano-delivery systems for delivery of water-insoluble and poorly bio-available drugs."

LiftPort Carbon Inc.
A LiftPort Group Company "By bringing advanced carbon nanotube products to market now, LiftPort Carbon, Inc. (LPC) is working to develop the carbon nanotube technology which will enable creation of the space elevator in the future."

Liquidia Technologies
"... enables and develops an entirely new class of applications in microfluidics, soft lithography and nanoparticle fabrication, based on a novel fluoropolymer materials platform."

Liquid Minerals Group
"LMGI's smaller nano particles allow lower dosage rates and, therefore provide customers a lower treatment cost while increasing the passivation of contaminant metals found in heavy fuel oils. LMGI's combines established chemistry knowledge into the expanding art of nanotechnology that has allowed us to reach higher levels of concentration and performance."

Lucent Technologies
Bell Labs Innovations

Lumera
"... develops proprietary polymer materials and products based on these materials for a broad range of applications. We engineer polymer materials at the molecular level – commonly referred to as nanotechnology – to optimize their electrical, optical and/or surface properties."

Lumiphore
"... develops and markets biological detection systems based on luminescent lanthanide complexes, which provide a unique combination of sensitivity, reliability, flexibility and high throughput."

Luna Innovations
"... a research and development company specializing in developing and commercializing basic research into cost-effective products that are beneficial to society."

Luna nanoWorks
A division of Luna Innovations Incorporated. "Luna nanoWorks' new composition of matter is

called Trimetasphere™ carbon nanomaterials (M3N@C80) -a fullerene sphere enclosing three metal atoms in a nitride molecule. The entrapped metals provide unique physical, chemical, thermal, magnetic, biological, optical and electronic properties that differentiate them from other carbon nanomaterials."

Luxtera
"... developing breakthrough photonics products. The company's technology is rooted in Caltech developments in the field of nanophotonics: optical structures an order of magnitude smaller than those traditionally used in integrated optical devices."

MagForce Nanotechnologies AG
Nanotechnology-based cancer therapy

Materials and Electrochemical Research Corporation
"Devoted to high-technology materials and electrochemical research with emphasis on advanced composites, powders, coatings and fullerenes ..."

Materials Modification Inc. (MMI)
"... aim of developing new materials and processes in the field of Materials Engineering."

Matrix Semiconductor
"Matrix has developed and patented the technology to build 3-dimensional memory by stacking memory arrays vertically."

Mayaterials Inc.
Organic/Inorganic Nanocomposites, Nanocomposite Coatings, Nanoporous Materials, Photonic Materials, Core-Shell Nanocomposites

MechanomadeŽ Ball Milled Nanophased Materials (MBN)
"... produces nanophased powder materials using a high-energy milling process."

Medical Murray
"Medical Murray has extensive experience in the injection molding and development of nanoscaled plastic parts."

Meliorum Technologies
"... fabrication of high-quality nanomaterials for university and industrial research, and application development."

Melstream Industries
"Through experience in the industrial and commercial water conditioning sector we offer environmentally safe media for numerous applications."

MEMSCAP
"... is a provider of innovative MEMS-based solutions for the design, development and manufacture of telecommunications products."

MEMS Optical
Supplier and manufacturer of both refractive (microlens arrays) and diffractive (beam shapers, beam splitters, etc.) micro optics, and of MEMS devices such as scanning tilt micro mirrors and deformable mirrors.

MEMX
"The MEMX technical team spent ten years at Sandia National Laboratories developing and perfecting the revolutionary SUMMiT V MEMS technology. We are now bringing the technology out of the labs and into the Commercial Sector." They work extensively with self-assembled monolayers and other nano-films and coatings to improve performance and reliability of their products.

metaFAB
"metaFAB offers innovative, high-level solutions based MicroNanoTechnology convergence. metaFAB is a dynamic component of the UK DTI MicroNanoTechnology Network. metaFAB integrates the resources of diverse research centres and supply chain partners."

Metcomb Nanostructures
"With its patented Integrated Nanostructure Control process, Metcomb leverages nanotechnology to create the first aluminum foam that is uniformly consistent, mirroring the way Mother Nature creates organic load-bearing materials, such as wood, bone and coral."

MetaMateria Partners
"... develops and manufactures nanopowders and components for fuel cells, batteries, membranes, other electrochemical devices, filters, rocket nozzles, and catalyst supports."

Miasolé
"... manufactures the first solar technology inexpensive and plentiful enough to make solar power practical for large-scale use."

Micralyne
"A manufacturer of microfabricated and MEMS-based products for leading instrumentation companies worldwide."

MicroTechNano Inc.
Distributes high quality nanotube materials.

Mimotec SA
Manufactures customized micromolds and micro-components.

Micro Materials
Nanoindentation, Scratch Testing and Impact Testing

Minatec Innovation Center
Centre for Innovation in Micro and Nanotechnology. MINATEC, CEA Leti, INPG, Grenoble, France

MITRE Corporation Nanoelectronics & Nanocomputing Home Page
Reviews current nanotechnology research and people behind it, downloadable copies of several widely-used articles. Nanoelectronics and Nanocomputing focus.

Mitsui & Co., Ltd. Nanotechnology Department XNRI Group
"At XNRI, we are focused on developing unique technologies that have been enabled by the fusion of a diverse range of disciplines centering around nanotechnology, technologies that will allow us to direct our efforts into research areas related to the environment, energy and medicine."

MIV Therapeutics
"... an advanced stage, research and development company pursuing the commercialization of the next generation of fully biocompatible coatings for stents and other medical devices with the intent of providing healing solutions for cardiovascular disease and other conditions."

Molecubotics
"Molecubotics intends to develop a general method for assembling complex nanostructures, using components and methods from biotechnology."

Molecular Electronics Corp.
"MEC is presently forming strategic alliances with industry partners for commercialization of the intellectual property, and for manufacturing and marketing of specific products based upon MEC's intellectual property."

Molecular Nanosystems
"... is engaged in research, development and production of nanotube-oriented products and systems using leading-edge nanotechnologies."

Moore Nanotechnology Systems
"... is dedicated to the development of ultra-precision machine systems, typically utilizing Single Point Diamond Turning and Deterministic Micro-Grinding technologies, for the production of plano, spherical, aspheric, conformal, and freeform optics."

mPhase Technologies
"... has entered into a broad sales, marketing and development partnership with Lucent Bell Laboratories to commercialize nanotechnology for new batteries."

Nanergy
"We have a focused R&D on our patented, demonstrated proprietary method to store hydrogen in carbon nanotubes and several collateral applications. We believe this will lead to products for us in two to three years."

Nano and Giga Solutions
"Our main focus is computational modeling and simulation for nanotechnology applications. We develop and apply different computational and experimental tools to solve complex multi-disciplinary problems in process, materials, and device design related to the development of advanced technologies."

Nano Interface Technology, Inc. (NITI)
"We are a pioneering research organization committed to develop novel nanotechnologies in biotechnology, material sciences and the drug delivery areas."

Nano-C
"... has developed the leading technology for the manufacture of commercial scale, high-purity fullerenes and other nanoscale fullerenic materials."

NanobacLabs
"We are deeply involved in research and medical nanotechnology involving infection by a newly discovered pleomorphic human pathogen known as Nanobacterium sanguineum. We are working with academic researchers throughout the world to develop medical therapies that eradicate the diseases associated with these nanobacteria."

NanoBio Corporation
"... a biopharmaceutical company whose mission is to develop and commercialize its high-value Rx and OTC pharmaceutical products enabled by its patented NanoStat™ antimicrobial nanoemulsion technology."

NanoBioMagnetics
"... engaged in the development and commercialization of magnetically responsive nanoparticle technologies for a range of human health applications for an emerging area of nanobiomedicine referred to as Organ-Assisting-Devices (OAD's)"

NanoBlox
"... develops proprietary products and processes based on a new phase of carbon produced in accordance with NanoBlox patent(s). The building block for the company’s technology is a 5 nanometer diameter, sp3 carbon, nanodiamond particle with a chemically tunable surface."

NanoCarbLab
(NCL) "A nanotechnology division of MedChemLabs Inc. (MCL). Main purpose is supplying carbon nanotubes of highest grades of purity and developing methods of bulk production."

NanoCarrier
"... striving for advancement in the development of new medicines and diagnostician/pathognomy. Integration and development of "Bio and Nano" technology is the ultimate mission and challenge for NanoCarrier."

Nanocerox
(formerly TAL Materials) "...is a nanotechnology company providing mixed-metal oxide nanopowder-based research and development solutions to corporate customers for photonics, energy conversion, catalysis, and structural ceramics."

Nanochem
"NanoChem products in the chemicals and wastewater treatment industries enhance productivity through effective use of new materials with novel properties and superior performance."

Nanochip
Design of Micro-Electro-Mechanical Systems (MEMS) silicon memory.

Nanoclay
"CloisiteŽ additives consist of organically modified nanometer scale, layered magnesium aluminum silicate platelets. The silicate platelets that CloisiteŽ additives are derived from are 1 nanometer thick and 70 ? 150 nanometers across."

Nano Cluster Devices
"... novel methods for taking clusters of atoms and forming them into electrically conducting wires."

NanoComputer Dream Team
Multidisciplinary project to make first nanometer supercomputer via the Internet.

Nanoco
High-performance nanoparticles

Nanoco Technologies
"... develops and manufactures fluorescent nano-crystals from semi-conductor and metallic materials known as quantum dots."

Nanocomms
"... unique IP in the area of design, development and manufacture of polymer micro systems for photonic and life science applications."

Nanocomp
"... design and manufacture of diffractive optics and microstructures."

NanoConduction Inc.

nanoCoolers
"... advanced cooling technology, nanoCoolers offers thermal management solutions that will revolutionize the computing, communication and refrigeration markets among others."

Nanocopoeia
"... a drug formulation company bringing a proprietary ElectroNanoSpray™ technology for producing nanoparticles to the pharmaceutical and medical device industries."

Nanocor
"Nanocor is a new operating subsidiary of AMCOL International Corporation. We are the largest global supplier of nanoclays specifically designed for plastic nanocomposites."

NanoCraft
"... nearly pure Nanohorns and Nanotubes ... to serve both research and industry orders."

NanoCraft
Detailed investigations with SPM-Techniques, Scanning Tunneling Microscopic analysis; Sample

preparation and surface modification; Production of chemically modified tips; Evaluation, analysis and interpretation

Nanocrystal Imaging Corporation
(NIC) " ... was founded in October 1997 to exploit some of NCT's discoveries in the creation of high quality digital x-ray images. ... Our practice of nanotechnology is based upon phenomena which produce non-linear attributes and properties of single atoms when confined within nanocrystals of sizes between 2 - 5 nanometers."

Nanocs
a research and development company focusing on hydrocarbon polymers, nanophase carbon materials (carbon nanotubes, nanodiamond, nanocomposite) process and related fabrication systems.

Nanocyl
"...is exploiting and valorising new discoveries and a strong portfolio of intellectual property developed by Prof. Janos B. Nagy's team at the University of Namur in the field of Carbon Nanotubes."

NanoDevices
"... leverages MEMS fabrication to enhance precision nanoscale metrology and to build a foundation in nanotechnology."

Nanodisc
"... owns an exclusive, world-wide commercial license to all applications of Nanodiscs™ – nano scale, discoidal structures composed of specially engineered proteins and phospholipid bilayers."

NanoDynamics
"... founded in 2002 to develop and manufacture high performance nanomaterials for a wide array of customers and for integration into proprietary components and systems. The Company is pursuing commercial manufacture of nanocrystalline metals, ceramics, and carbon materials for a wide range of applications in energy, portable power, biomedical, transportation, electronics, defense, and many other industries."

NanoEner
A wholly owned subsidiary of Ener1. "... formed to develop and market advanced nanomaterials and nanotechnologies. NanoEner's proprietary technologies enable unprecedented speed and control in synthesis and deposition of nanomaterials for a wide range of applications."

Nanofilm
"... founded to develop and commercialize ultra-thin films, called nanofilms, to enhance the durability, clarity, ease of use and performance of transparent materials."

NanoFocus
"... provides measuring solutions that meet the demand for highly accurate measurement of micro- and nanostructures."

Nanoforce Technologies
"... aggressively pursue Nanotech research opportunities, primarily focused in the area of improving commercial products used in day-to-day activities."

Nanofreeze
"... founded in September 2005, as a spin off from research performed at Lund University in the field of thermoelectrics."

Nanogate Technologies GmbH
"... is concentrating at present on the commercial areas of Surface technology and Ceramic nanotechnology."

Nanogen
Integrates advanced microelectronics and molecular biology.

Nanogist
Applications of nanoscale silver particles. English version coming soon.

Nanographite Materials
(NGM) "... a joint venture between Applied Sciences, Inc., (ASI) and GSI Creos Corporation, (GSI). ... production and marketing of PyrografŽ-I vapor grown carbon fiber, and composite materials based on this fiber."

NanoGram
"... is a developer and licensor of core process technology enabling the manufacture of unique nanoscale compositions for optical, electronic, and energy storage applications and products. The company has developed extensive intellectual property that is expanding the boundaries of nanomaterials technologies by enabling the development and manufacturing of new generations of materials, devices, components and applications."

NanoGram Devices
"... founded in 2002 as a spin-out from NeoPhotonics Corporation, develops novel medical device applications based on its proven and patented laser-based nanomaterials synthesis process. The company's products include patented nanomaterial-based medical power sources that enable dramatically smaller, longer lifetime medical devices with superior performance."

NanoHorizons
NanoHorizons A Nanoscale materials and devices company providing solutions for: Drug discovery, Flexible Microelectronics, and Medical Diagnostics & Monitoring.

NANOIDENT
Organic semiconductor based photonic sensors.

Nano-Infinity Nanotech Co.
"... a specialized manufacturer of nano material and related nanotechnology for health beauty product, including healthy deodorant, body guard, beauty care, nano materials & semi-finished

goods etc."

NanoInk
"... in business to commercialize the process known as dip pen nanolithography™, or DPN™. We have developed a platform process for nanotechnology that enables our customers and partners to create revolutionary new products and services using a molecular “bottom-up” approach to nanofabrication."

NanoLab
"... convert research ideas into marketable nano-technologies."

NanoLab Systems
"Our main focus area is Carbon NanoTube based applications where we have created novel modification processes and devices. These processes are widely used by companies in polymer industry where we have made exclusive license agreements with corporations in specific segments."

NanoLife
"NanoLife Holdings has focused its commercial efforts on nanotechnology since 1999. Our thrust has always been focused on more efficient releases of energy in a reaction between nano-particles."

NanoLight
Produces a mercury free fluorescent tube, the NanoLamp. Utilizing a cathode "based on Field Emission of electrons from a wire covered with carbon nanotubes."

Nanolayers
"Nanolayers is the commercial name chosen for Dr. Shlomo Yitzchaik's Molecular Layer Epitaxy (MLE) technology -- a breakthrough, patented nanotechnology from his laboratory at The Hebrew University of Jerusalem. Nanolayers is a basic enabling technology for semiconductor, microelectronic, materials, bioelectronics, telecommunications and multiple other industries that constitute central growth markets in the upcoming decade."

Nanoledge
"... designs and develops high-performance and multi-functional materials and fibers out of carbon nanotubes (CNT)."

NanoLogix
"... a biotechnology / genomics company owning 31 issued patents with applications in nanotechnology, hydrogen gas production, medical drugs/devices, bio-defense sensors and bioremediation."

Nanolume "... founded in 1998 for the purpose of creating devices from synthetically produced nanocrystalline semiconductors. It is an outgrowth of research done by the principals while at Duke University."

NanoMagnetics Ltd
"... is developing advanced magnetic materials for the information storage industry using its patented protein-based technology. These materials have the potential to replace the magnetic thin

film technology used today by the hard disk industry, which is seeking to overcome the approaching physical “superparamagnetic” storage density limit."

NanoMarkets
"... analyzes the market opportunities and disruptions brought about by advances in technology at the micro and nano scale."

Nanomat
"... developed efficient and cost-effective processes to manufacture nanomaterials to meet a wide range of custom needs and specifications."

Nanomaterials and Nanofabrication Laboratories (NN-Labs)
"... production, processing and applications of semiconductor nanocrystals and dedron ligands."

Nanomaterials Company
Producer of complex nanopowders and nanostructured materials.

Nanomaterials Discovery Corporation
"... combines the power of combinatorial chemistry with the versatility of electrochemistry to discover and refine nanomaterials with high economic impact. NDC focuses on discovering and refining the nanostructured materials that can fundamentally change the world in which we live."

Nanomaterials Research LLC
"... is involved in the research, development, and manufacture of gas sensors, electronic components, and unique microfabricated devices (e.g., ceramic MEMS)."

NanoMaterials Technology
"... develops and provides technologies for the commercial production of nanosized materials which are applied in industrial markets including the chemical, pharmaceutical, and electronics markets."

NanoMech
"... mission is to provide innovative nanostructured coatings, related manufacturing processes and systems for a broad range of applications that improve the quality of life."

Nanomedica
"... mission is to become a global leader in the development of dual-action therapeutics for the treatment of cancer."

NanoMed Pharmaceuticals
"... developing nanoparticle-based advanced drug delivery systems to diagnose and treat disease."

NanoMerk
"... distribute and commercialize high technology products that offer a different and innovative solution to everything available in the market."

NanoMetalGlobal
"... manufacturing nano metal powders and nano powder making equipment."

Nanometrix
"... has developed a unique, innovative, patented and effective process (the MG-1 Process) to structure, organize and assemble molecules and atomic-size particules."

Nanomix
(formerly Covalent Materials Inc.) New materials are designed, synthesized and characterized at the nanometer scale for a myriad of applications in industries ranging from electronics to biotechnology.

NanoMuscle
"... designs and manufactures advanced motion technologies for use in a wide range of consumer devices. Our breakthrough products displace conventional electromagnetic motors and solenoids, and for the first time provide miniature, affordable motion."

Nanon A/S
"... a world leader in the nanoscale manipulation of "difficult" polymers, such as silicone, with the goal of optimizing performance - without compromising the properties of the base material."

Nanonize Technologies Corp.
"... focusing on the research and development of commercial products based on nanotechnologies in addition to products of nanopowders."

NanoOpto "... is applying proprietary nano-optics and nano-manufacturing technology to design and make components for optical networking. Based on years of research, the company's technology allows orders of magnitude more rapid prototyping, higher performance and lower overall system cost. Both on its own and with corporate partners, NanoOpto will use subwavelength techniques to produce better conventional optical components and also to create new classes of integrated components."

nanopac
"... photo catalytic/functionalized materials, processing technology for powders, coatings and composites, control of surface modification, analysis/evaluation/optimization of materials & processing, and design of Components and Systems (Air purification, Water purification)."

NanoPharm
"... develops novel carrier systems for the treatment of brain tumors and nervous system disorders using biodegradable nanoparticles. Nanosphere drug targeting systems allow any drug to cross the blood-brain barrier."

Nanopharma
A privately-held spinoff from Massachusetts General Hospital, founded to develop advanced drug delivery systems, and to provide fully biodegradable nanoscopic drug delivery vehicles based on proprietary molecular constructs and "biological stealth" materials.

Nanophase Technologies Corporation
"... a leader in solving product problems through its patented and proprietary nanocrystalline technology."

NanoPierce

Nanoplex Technologies
"... focuses on developing and commercializing products based on novel metal nanoparticles and nanoparticle-based surfaces."

Nanopolis
Whether you are a researcher, industrialist or educator involved in the emerging field of nanotechnology, Nanopolis multimedia distributed knowledge network and encyclopedia series provides you a straightforward way to understand the Nanotech world and to be understood within.

Nanopool
"The German Ministry of Research and Education promotes the project “Ultra Thin Layers” as being one of seven clearly defined disciplines of nanotechnology. The manufacturing of those ultra thin nano layers is the core competency of nanopool GmbH."

Nanopore
" ... founded in 1993 with the purpose of commercializing high porosity/high surface area materials for a wide range of applications including adsorbtion, gas separation, advanced thermal insulation, low-K dielectrics, and optics."

Nanopowder Enterprises
(NEI) "Incorporated in 1997, NEI invents and develops proprietary, patented technologies for producing nanopowders and nanostructured intermediates."

NanoPowders Industries
"... metal powders on a production scale to meet the needs of present and future markets."

NanoPrism Technologies
"... a platform of patented technologies and proprietary know-how to manufacture and commercialize various nanomaterials with superior performance attributes."

Nanoprobes
"...was founded to develop the most sensitive reagents and technology for detecting biological molecules."

NanoProducts Corporation
(formerly NanoEnergy Corp.) "...supplier of nanoscale powders and products derived from these powders. ... employ patented technologies to produce nanoscale particles (nanotechnology building blocks), which are currently being manufactured in commercial volumes."

Nanoscale Combinatorial Synthesis Inc.

(Nanosyn) "...is focused on developing integrated technologies for miniaturized ("nanoscale") to milligram scale combinatorial synthesis. ... We produce combinatorial libraries with unique design features and provide access to an existing compound collection approaching 100,000 individually purified and analytically characterized small molecules for drug discovery."

NanoScape
"...is a new enterprise in the field of materials discovery concerned with the design and development of novel, functionalised materials with the potential to open up new processes within the chemical industry."

Nanosciences
"... providing the most advanced products, systems, & services for nanodevice, MEMS, BioMEMS and MST applications."

Nanoscience Technologies
"... manages one of the few research efforts providing a viable mass manufacturing methodology and vehicle to deliver this technology (functional molecules) to the marketplace for commercial use."

NanoSelect
"... a nanotechnology company developing chemical and biological sensors to monitor the quality and safety of our municipal water supply systems."

Nano-Size
"... specialize in research, development and production of exceptionally high specific surface area powders, nanoparticle dispersions and ultra fine grinding."

Nanosolar "... focused on bringing to market a new generation of very-low-cost solar electricity cells, which are light-weight, flexible, and easily adjustable in shape. Based on flexible plastics, solution coating, and self-assembling nanostructures, Nanosolar's technology combines advanced nanostructural control with simple production processes to enable efficient very-low-cost solar cells."

NanoSonic
"...have developed new molecular self-assembly processes that allow control of synthesized material structure at the nanometer level, as well as the manufacturing of new materials with designed constitutive behavior."

Nanospectra LLC and Nanospectra Biosciences "... founded in January 2001 to commercialize technology developed at Rice University by Dr. Naomi Halas and Dr. Jennifer West. The company's IP portfolio includes a broad range of industrial, photonic and biomedical applications that are enabled by the ability to manufacture and tune nanoshells across a wide range of optical

properties. Nanospectra Biosciences, Inc. was formed in August 2001 to develop the life sciences applications of this technology."

Nanosphere

Nanosphere "... a privately-held life-sciences company located just outside of Chicago, Illinois. Our proprietary technology uses the unique properties of nanoparticles. We have developed a comprehensive system for detecting bio-molecules such as nucleic acids and proteins. Nanosphere, Inc. will become the global standard for molecular diagnostics."

- NanoSperse

"... founded in 2003 to enable the rapid commercialization of polymer nanotechnology by utilizing proprietary platform technology developed by the Air Force Research Laboratory and the University of Dayton Research Institute."

- Nanostellar

"... a Menlo Park-based Nano-Composite Material company that develops highly efficient Platinum Nano-Composite Catalyst solutions."

- Nanostream

"We create microfluidics chips to serve our customers' needs in small-scale fluid manipulation. Using a unique modular approach, Nanostream's technology helps automate and miniaturize fluid-handling. This approach also allows for extremely fast prototyping, seamless scale-up and mass customization with turnaround time in days."

- Nanostring Technologies

"NanoString Technologies is developing a patent-pending nanotechnology-based platform for high speed, completely automated, robust, highly multiplexed, single molecule identification and digital quantification."

- Nanostructural Analysis Network Organisation - Major National Research Facility (NANO-MNRF)

"The NANO-MNRF is the peak Australian facility for nanometric analysis of the structure and chemistry of materials in both physical and biological systems."

- Nanostructured & Amorphous Materials, Inc.

"... a provider of various nanostructured and amophous materials with a high quality, a large quantity, and a low cost."

- Nano Superlattice Technology

"... focused on research and development and mass production of nano-scale coating technology."

- NanoSurf

"... main focus is on the research and development of scanning probe microscopes (SPM) and positioning devices with nanometre resolution."

nanosys

Nanosys A development stage company focused on building nanotechnology-enabled systems. Larry Bock - president and CEO. They have an exclusive licensing arrangement with Harvard University for a portfolio of fundamental intellectual property, including nanowires, which were developed by Harvard Professor Charles Lieber.

Nanotec Pty
"... ready to use product solutions for all kind of surfaces. We offer development services for enterprises which are interested to expand their product lines."

Nanotech
Nano-composite powders

Nano Tech Coatings
Material coatings using the sol-gel process for manufacturing inorganic-organic hybrid polymers.

NanoTechLabs
Various nanotubes, nanoparticles, and nanowires.

Nanotechnica
A subsidiary of Arrowhead Research. "... seeks to develop a variety of nanoscale devices and systems."

Nanotech Semiconductor
"... a fabless chip company, designing and supplying Driver and Receiver ICs for the fiber-optics communications industry."

Nanotec-USA
"... partnered with Nanotec Pty Ltd. We have introduced true nanotechnology water repellent and easier to clean/self cleaning permanent treatments to the United States."

Nanotechnology Development Corporation
(NTDC) Formed to rapidly exploit the advances being made in the field of Digital Matter Control.

Nanotechnologies Inc.
"... provide unique materials for a wide variety of industries and performance-driven applications."

Nanotechnology Victoria
" ... a vehicle for optimising benefits to Victoria from advances in nanotechnology and related sciences."

Nanotecture
A materials science company that has developed a platform technology based on nanoscale, porous lattices. The company’s first application is energy storage for batteries and supercapacitors.

Nanoten
Nanotechnology Consulting Services, founded by Dr. David Tomanek (of Nanotube fame).

Nano-Tex
"... a research company founded on the principles of nanotechnology creating new or improved textile properties through molecular engineering. ... The principles of nanotechnology are utilized to create exceptional performance in everyday items: apparel, home furnishings, commercial interiors, industrial fabrics"

Nanotherapeutics
"... has made new discoveries in the area of nanotechnology and is applying them to the development of novel drug therapies." As of July 5, 2002 Nanosphere and Nanocoat have merged to form Nanotherapeutics, Inc.

Nanothinx
"... large-scale, high-yield and low-cost production of carbon nanotubes."

Nanotrope
"... founded in 2004 to commercialize nanoscale droplet technology being developed at the University of California, Irvine. The droplet technology provides high-precision, digital control of biochemical processes at the nanoscale."

Nanotubes Broker
"As a visitor of Nanotubes-broker.com, you are entitled to a 5% price reduction on your nanotubes purchases from the american or european suppliers ..."

NanoTwin Technologies
"... focused on improving the quality inside your everyday, personal environment." Makers of NanoBreeze air purifier.

nanotype
"... will enable next generation evolution in drug development and diagnostics through application of our proprietary C-FIT™ (Congruent Force Intermolecular Test) technology. C-FIT™ unites nanotechnology and biology..."

Nanoventure
"... a holding company, predominantly into established, growth oriented enterprises in nanotechnology and adjacent technology fields."

NanoViricides
"We believe that nanoviricides are the next great advance in medicine."

Nanoway
"We develop innovative approaches and offer superior solutions for the low temperature community."

Nanox
"... mechanochemical synthesis and perovskite formulations for low temperature diesel oxidation catalysts (DOC) and other types of autocatalysts."

Nano-X
"... develops and produces new materials from chemical nanotechnology with multi-functional properties."

Nantero
"... is developing NRAM, a high-density nonvolatile random access memory chip, using nanotechnology. The company's objective is to deliver a product that will replace all existing forms of memory, such as DRAM, SRAM and flash memory, with NRAM serving as universal memory."

National Composite Center (NCC)
"... promoting, developing and applying advanced composite technology to the aerospace and defense, automotive, commercial and infrastructure markets."

NaturalNano
A subsidiary of Technology Innovations, LLC "... processing and applications of naturally occurring nanoscale materials, such as halloysite, or manufacturable at very low cost and in high quantity."

NaWoTec
(nano world technologies) "Numerous international patents on nanolithography with electron beam induced reactions (formation of nano-structures on surfaces) and especially modified high resolution electron beam systems are the basis for successful applications in electronics, nano-analytics, bio-nano physics and micro-optics."

nCoat
"... a nanotechnology research, commercialization, licensing and distribution company. Through its subsidiary companies, nCoat develops and distributes commercially viable proprietary nanotechnology and traditional coating products."

NEI Corporation
"... synthesis and processing of nanomaterials ..."

NeoPhotonics
"... designs, manufactures and markets planar optical components through the deposition of nanoscale light enhancing materials."

NexTech Materials
"... is developing a range of advanced ceramic products for the energy, automotive, medical, defense, and aerospace industries. Its core competencies are inorganic materials development, ceramic product development, synthesis and dispersion of nanoscale oxides, and scale-up of advanced powder synthesis technologies. Some of the products under development are described below."

Nextreme Thermal Solutions
"Nextreme's devices employ nanoengineered layered semiconductors called superlattices that are created by stacking thousands of layers of thermoelectric material, with the layers between 1 and 5 nanometers thick."

*n*Gimat Co.
"An intellectual property company and a manufacturer of engineered nanomaterials in the following areas: nanopowders, thin film coatings, and devices."

NIC Industries
Powder, ceramic, and elastomeric coatings

NSC-Nanosemiconductor-GmbH "... designs and fabricates semiconductor wafers grown by Molecular Beam Epitaxy in (In, Al, Ga) As with Si and C doping elements system using proprietary nanoepitaxial techniques for optoelectronic and microelectronic applications."

NSTI Nano Science and Technology Institute "... a leading, global nanotechnology consultancy. Through its knowledge network, NSTI offers high-value services powered by a unique network of established high-level and long-term relationships with leaders in the nascent fields of nanotechnology."

Ntera A broad-based nanotechnology company with current applications in flat panel displays, medical diagnostic sensors and targeted drug delivery.

Nucryst
Noble metal nanocrystalline pharmaceutical and medical device technologies.

NutraLease
"The Technology is a patent pending called Nano-sized Self-assembled Liquid Structures (NSSL) and is related to the nano-sized vehicles that are used as vehicles to targeted compounds (such as nutraceuticals and drugs)."

Nyacol
" We specialize in colloidal dispersions of inorganic oxides and powders prepared from these dispersions. We use nano particle technology to create these inorganic metal oxides and organic based silica sols that are largely used as flame retardants, abrasion resistance additives and as binders for catalysts, refractories and ceramic fibers."

Obducat Developer and supplier of technologies and processes for the production and analysis of very fine structures (micro and nano structures).

OMM
"... developed the technology of optical MEMS....also incorporated two other core competencies: optoelectronics packaging and automated manufacturing of photonic switching subsystems."

Omni-Lite Industries

"... one of the world's leading developers of precision components utilizing advanced composite materials and computer-controlled cold forging techniques"

- Optiva

"Benefiting from over two decades of successful large-scale research in supramolecular engineering, Optiva is the first to develop a commercial mass-production process optical self-assembling materials ("nanomaterials"). Optiva's first family of thin crystal films (TCF™) products will target the flat panel display industry, offering significant cost and performance advantages over traditional polarizer film alternatives."

- Optotrack

"... research and development of novel optical, imaging, chemical, as well as biological sensors and microsystems. Optotrack is dedicated to commercializing its proprietary intellectual properties based on microfabrication and nanotechnology to seize rapidly growing market opportunities in the healthcare, communication, and homeland security industry."

- Orla Protein Technologies

"... a bio-nanotechnology company integrating biological systems and physical devices through engineered protein interfaces."

- Ormecon

Commercialized special kinds of conductive polymers ("organic metals") highly engineered nanostructured materials made from organic building blocks.

- Owlstone Nanotech

"Using leading-edge nanofabrication techniques, Owlstone has created a complete chemical detection system on a chip. A hundred times smaller - and a thousand times cheaper - than other currently available devices, the Owlstone detector overcomes many of the limitations of traditional detection technologies."

- **Oxford Nanotechnology**

A research and development company based in Oxford, U.K. Our research specialty is into the use of ion beams to create nanostructures, but we also have interests in nano-scale electronic architecture, quantum computing and other nanotechnology research. We are currently looking to expand our operations, and to employ a number of staff research scientists.

OXONICA

Oxonica "... engaged in building a portfolio of in-house developed new product opportunities and commercialising IPR that has been researched within the Engineering Science and Biochemistry Departments of The University of Oxford."

- P2i

"P2i Ltd’s plasma surface enhancement process is a 21st century technology that gives everyday products extraordinary performance levels of oil and water repellency."

- Pacific Fuel Cell

"... leader in the development of carbon nanotube-based membrane electrode assemblies (MEA's)."

Pars Environmental
NanoFe^{TM} remediation technology for soils and groundwater.

PChem Associates
"... developed a patented nanomaterial technology for printed electronics."

Pennsylvania NanoMaterials Commercialization Center
"A primary objective of this new center will focus on establishing Pennsylvania as the first-to-market leader in products and technologies that involve nanomaterials."

Percenta Europe Ltd
A wide range of goods to protect surfaces; sealants and coatings.

PlasmaChem
Nano-materials and -powders, detonation-, vacuum-, plasma- and ultra-thin film technologies and their biomedical and technical applications.

Plastic Logic
"... a leading developer of plastic electronics technology. It develops and exploits new manufacturing processes which combine the power of electronics with the pervasiveness of printing."

Platypus Technologies
"... develops, produces and markets nanotechnologies for the life sciences. We produce a variety of nano-structured surfaces for use in research and are also developing a range of products that derive from a proprietary platform technology for the rapid detection of molecular interactions."

Powdermet Inc.
Specializes in modifying powder and particulate surfaces through applying metal and ceramic coatings onto particulate matrices. We design, develop, and manufacture metal and ceramic nanoengineered fine powders and particulates using fluidized bed surface modification technology.

PowerMetal Technologies
A provider of electrodeposition and product engineering services for nanometals in the consumer and sporting goods industries.

Primet Precision Materials
An advanced materials company with expertise in controlling materials at the micro and nano scales to create new and useful macro effects.

Programmable Matter Corporation
"... a research corporation based in Lakewood, Colorado. PMC was formed for the express purpose of exploring and developing dynamically configurable ismart materials and the technology associated with them."

PSI-TEC Corporation
"... a developmental stage company that engineers next-generation electro-optic plastics.

pSivida
"... an Australian listed public company that is committed to the biomedical nanotechnology sectors. It has as its core focus the development of nano-structured porous silicon for multiple potential applications in human and animal healthcare through its UK operating subsidiary, pSiMedica Limited."

Q Chip
"... a precision particle engineering company with a unique microfluidic technology enabling sophisticated manufacture of micro- and nano-particles for the high value added manufacturing industries of pharmaceutical, food and cosmetics."

QD Vision
"... quantum-dot materials advancements and manufacturing process development for the next-generation of displays."

Qtech Nanosystems
"... a 'technology incubation enterprise' focussed on making products based on nanotechnology."

Quantiam Technologies
"Develops and commercializes advanced materials based on nanotechnology; manufactures powders, catalysts and coatings for the petrochemical, energy and aerospace industries; provides consulting, technical and research services for characterization of nanomaterials and surfaces; extensive collaboration and seed investment in innovation."

Quantiscript
"... a nanotechnology company developing process solutions aimed at next generation lithography (NGL) for the microelectronics industry."

Quantum Dot Corporation
Develops and sells novel solutions to accelerate the discovery and development of functionally validated novel drug targets at the cellular level.

Quantum Logic Devices
"... focus is on single-electron transistor platforms, based on quantum dots, that use very low power."

Quantum Polymer Composites
Thermoplastic Rubbers (TPR) and Rejuvenates of Rubber Scraps.

Quantum Polymer Technologies
Self-assembling polymer nanowires.

Quantum Precision Instruments
"... patented technology forms the foundation for a family of nanoTrek(TM) nanotechnology

MEMS and NEMS sensors having applicability in a wide range of industries: from medicine and bio-technology, through to aviation, aerospace, defence, automotive, seismic, mining and others."

QuantumSphere
"... a leading manufacturer of metallic nanopowders for aerospace, defense, energy, and other markets."

QuarTek Corporation
Active research programs in smart materials, nano-sensors for diagnostics, nano-tagging, and remote sensing.

QuNano AB
"... a venture-backed, development-stage nanotechnology company focused on development and commercialization of next generation quantum nanoscale semiconductor materials and devices for the electronics, optoelectronics and sensor markets."

QinetiQ Nanomaterials Ltd.
QinetiQ Nanomaterials Ltd "QNL is a fully owned subsidiary of the QinetiQ Group, Europe's largest science and technology organisation. Across QinetiQ there are over 150 scientists and engineers working in nanomaterials and nanotechnology. By linking them with a proven manufacturing technology we have been able to make significant progress in addressing the key issue of bulk supply of nanometric material - the essential lifeblood of the technology."

Radiation Shield Technologies (RST)
"... proud to offer Demron(TM), the new standard in personal radiation protection. This revolutionary technology is currently produced as full body suits, gloves and boots."

RAND
RAND (a contraction of the term "research and development") is the first organization to be called a "think tank." ...job is to help improve policy and decisionmaking through research and analysis.

Rave
"... a semiconductor equipment manufacturing company capitalizing on its proprietary nanomachining technology which takes advantage of developments in Atomic Force Microscopy, cantilever and Nanobit technology and 3D imaging software and their collective application to critical nanomachining solutions for the high technology marketplace."

Raytheon's Nanoelectronics Branch
Develops future-generation analog and digital technologies for commercial and defense applications in radar, communications, and sensor processing.

Reactive NanoTechnologies
(RNT) "In 1994 Dr. Tim Weihs (now a professor in Johns Hopkins University Materials Science and Engineering Department) and Dr. Troy Barbee of Lawrence Livermore National Laboratory made a groundbreaking discovery that held the promise of changing the way many materials are held together....Weihs and Barbee patented their invention in 1996, and set to the lengthy task of

making these foils ready to manufacture. In this effort they are joined by Professor Omar Knio, who is spearheading the computational modeling effort that will eventually lead to optimizing the foil's design."

Reade Advanced Materials
"... a manufacturer, value add custom processor, & global distributor of metal, alloy, ceramic, composite, usp, & fcc grade nano materials (nano particles, nano crystals, nano tubes, fullerenes, nano wires, nano fibers, quantum dots, doped nano particles, and encapsulated nano particles)."

Refinery Science
"... meeting the increasing demand for energy independence through nanotechnology"

Rockwell Scientific
"Rockwell Scientific is an independent, privately owned high technology enterprise with unique technical strengths in electronics, imaging, optics, materials, and information science. Its range of activities includes contract research and development services for the U.S. government and private sector companies, as well as commercialization of select technologies through licensing and the development, manufacturing, and sales of high value products closely related to its R&D efforts."

Rohm and Haas
"... specialty materials with revolutionary developments in everything from electronic materials and polymers for paints to personal care products ..."

Rolltronics
"Rolltronics Corporation, a Silicon Valley technology company, is developing roll-to-roll (R2R) manufacturing processes that will enable the production of electronic devices with dramatically lower costs and improved product features: thin, light, flexible, durable, affordable, faster to prototype and faster to market."

Rosseter Holdings Limited
"... a company that specialises in large-scale production of Carbon Nanotubes and related materials."

Research Triangle Institute (RTI)
"In 2001, RTI initiated a new focus on nanotechnology to consolidate and coordinate years of successful work in thermoelectrics, materials science and engineering, and filtration and aerosol technology."

RTP Company
"Specialty thermoplastic compounds from RTP Company provide conductive, structural, wear resistant, flame retardant, soft-touch, and color properties in over 60 engineering resins."

Salvona
"... develop and manufacture nanotechnology engineered controlled delivery systems and biodegradable devices for various commercial applications."

Samsung

Among others items, makers of nanpowders, and prototype nanotube-based FED (field emission displays).

Schoeller NanoSphere
"NanoSphereŽ finishing technology is revolutionizing the textile industry. Nature's phenomenal “self-cleaning principle” is now also available in textiles." English and German

SDCmaterials
"... mission is to commercialize new technologies that dramatically reduce the cycle time and the cost of successful discovery of new materials."

Seagate Technology
Storage Products

Seashell Technology
"... nanoparticles and nanostructured materials for academic research, development projects and for industrial processes."

Seldon Laboratories
"... a privately held nanotechnology company focused on incorporating the unique properties of carbon nanotubes into products for today's markets."

Sequoia Pacific Research Company
"... a chemical research and development holding company, which applies the science and art of Nanochemical Technology to create new products and unique chemical process applications."

SES Research
"... one of the first commercial manufacturers of Carbon Fullerenes to supply research communities worldwide."

Shenzhen JINGANGYUAN New Material
Specializes in R&D, manufacture, and marketing of nanodiamond powder and suspension, and their applications. With an annual output of up to10 million carats.

Shenzhen Nanotech Port Co
Research, manufacture, application and sales of carbon nanotubes.

Solaris Nanosciences Corporation
"... focused on developing nanoscale materials for large applications including the solar energy, display and vision markets."

Sol-Gel Technologies
"... proprietary platform nanotechnology is an innovative concept, that involves the encapsulation, at room temperature, of active ingredients in micro- and nano-sized glass (silica) matrices as well as nanospheres utilizing a chemical process called sol-gel."

SoluBest

"... using advanced polymer formulations to prepare nanotransporters for drugs having delivery or compliance insufficiencies."

Sono-Tek
"... applications such as the gentle drying of nano-particles, the isolation of highly effective pharmaceutical agents, the production of spherical ceramic matrices, or micro-encapsulation, as well as efficient and safe spray drying of aqueous and organic solvent-based solutions and slurries."

Southwest Nanotechnologies Produces Single-Walled Carbon Nanotubes (SWNT's) by Catalytic Disproportionation. See Controlled production of SWNTs at the University of Oklahoma

SpeciGen
"... intends to develop the next generation of targeted drug delivery and imaging agents using proprietary, nano-scale protein cage architectures."

Starnberger
"... over 40 years experience as supplier of high quality coatings. Our company was one of the first offering high quality fluorocarbon coatings."

Starpharma
"The Starpharma Group (Starpharma) was established to commercialise novel polyvalent compound technology discovered at the Biomolecular Research Institute in Melbourne, Australia .... comprises a class of high molecular weight, branch-like chemicals (dendrimers) and other polyvalent compounds with demonstrated activity against a broad range of viruses and other human diseases for which current therapies are inadequate." Teaming with Queensland-based PANBIO and Dr Donald A. Tomalia (the pioneer of dendrimer technology) they have established a new venture to develop products using dendrimer nanotechnology, called **Dendritic Nanotechnologies Limited**. Research facilities are at **The Center for Applied Research and Technology** at **Central Michigan University**, located in Mt. Pleasant, Michigan.

Standard MEMS
"... the largest independent high-volume manufacturer of Micro Electro Mechanical Systems (MEMS) for high technology markets."

Starfire Systems
"... offers a wide range of patented silicon carbide (SiC) ceramic forming polymers and material systems that companies use to meet performance and cost targets where high temperature, corrosion resistance, wear resistance, and weight are requirements that must be met."

Steward Environmental Solutions
"Solving Environmental & Industrial Challenges in Liquids and Gases with Nano-Materials."

Süd-Chemie
Makers of NanofilŽ - nanocomposite filler product line for polymer applications.

Sughrue Mion

SurgRx
Smart Electrode Technology™ - Nanoscale RF control for tissue welding.

SurroMed "... focused on applying its phenotyping technologies to accelerate the pharmaceutical discovery and development process and enable the precise diagnosis and personalized treatment of disease."

SuNyx
"Functional surfaces with optimised wetting and optical properties are the core technology of SuNyx Surface Nanotechnologies, a recent spin-off of the Bayer Corporation."

SUSS MicroTec
manufacturer and supplier of precision microelectronics equipment for the manufacturing and R&D environments.

SusTech Darmstadt
"... a center of competence for nanotechnology. Consisting of an international team of currently 30 scientists, it develops new materials, systems and products. Its location on the campus of the Technical University of Darmstadt makes it possible for our chemists, physicists, engineers and materials scientists to use the adjacent research facilities efficiently."

Swiss Center for Electronics and Microtechnology
(CSEM - Centre Suisse d'Electronique et de Microtechnique SA) CSEM is mainly active in the areas of microtechnology, microelectronics and information systems.

Tailored Materials Corporation (TMC)
"... an emerging manufacturer of ultra-pure, carbon Double-Wall Nanotubes (DWNT) for Field Emission Displays and other devices."

Targesome
"... a drug development and drug delivery company utilizing its proprietary nanoparticle technology to produce novel, efficacious drugs with improved properties. New or existing drugs, either antibodies or small molecules, can be attached to the nanoparticle to develop a new class of therapeutic agents."

Tekon
"... surface care protection for your glass, metal, stone, granite, plexiglass, vinyl and travertine surfaces."

Telomolecular Corp.
"... develops nanotechnologies capable of delivering large-molecule proteins across human cell

membranes. "

Tetronics
"... a wide range of technologies for the production and processing of powders in general and for nanopowder production specifically. In addition there are a number of processes involving carbon products, including graphite, carbon black and diamond production."

Texas Instruments

Thales Nanotechnology
A subsidiary of ComGenex, Inc. involved in exploring the use of continuous flow chemistry with nanotechnology in the field of drug discovery.

Thomas Swan & Co.
"... performance and speciality chemical manufacturer." Carbon Nanomaterials Business

T/J Technologies
"... designs, develops and manufactures advanced materials and devices for electrochemical energy storage and conversion."

Triton BioSystems
"... a development-stage company focused on the discovery and development of non-invasive targeted therapeutics that use heat to treat cancer and other life threatening and debilitating diseases." Currently working on pre-clinical product development of their Targeted Nano-Therapeutics system for advanced breast cancer.

Triton Systems
"... a fast growing materials company located just north of Boston. We provide our customers with unique materials solutions." Including polymers (e.g., polyolefins, polyesters, polyetherimides) that are enhanced by adding specialty nanometer sized particles (1x10-9 m) into the polymer matrix.

United Nanotechnologies
"... was established with an aim to cater products based on Nanotechnology for the Indian market."

Universal Display Corporation
"... a leading organic light emitting device (OLED) technology developer with a broad intellectual property portfolio, years of experience in OLED research and development, and entrepreneurial management expertise."

US Global Nanospace A Nano Science company developing innovative solutions for Homeland Security and Force Protections.

US NanoCorp
(USN) "... was incorporated April 1, 1996, as a vehicle to identify, develop, and commercialize

value-added products in the field of energy storage and energy conversion devices which exploit the extraordinary properties of nanostructured materials."

Vantage Resin Systems
"... a Nanotube-Neutral formulator of carbon nanotubes for thermoset epoxy applications."

Velbionanotech
"VBN is dedicated to furthering the art, science and practice of nanotechnology, where Biology, Chemistry, Physics and mechanical design converge Molecular scale."

Versilant Nanotechnologies
"... pioneers the invention, development and production of nanotechnology-based materials."

Voridian
A division of Eastman Chemical Company. "The world's largest manufacturer of polyethylene terephthalate (PET) for packaging and a global leader in the manufacturing of acetate tow."

Xenolix
a development stage enterprise, is inventing, researching and developing new precious metals analytic and extraction technologies based upon the science of nanotechnology.

Xerox Palo Alto Research Center
(PARC) Founded in 1970, PARC transformed computing with inventions such as the graphic user interface, client/server architecture, laser printing and Ethernet. Current activities are focused on Networks and Documents, Smart Matter and Knowledge Ecologies.

XetaComp
Specialty Nanopowders

Xidex
"... an Austin-based nanotechnology company in the business of developing carbon nanotube based mechanical, electrical and logic devices together with micro- and macro-scale products that incorporate these nanodevices."

Xintek
Formerly Applied Nanotechnologies, Inc. (ANI) "... established in October 2000 to develop and commercialize applications of carbon nanotubes in various industries such as telecommunications, electronics and medical imaging systems. The Company also fabricates carbon nanotubes for use in the above-mentioned industries and the research community."

Z-Medica
"... launched in January of 2002 to market an amazing medical product invented by its co-founder, scientist and former NASA team engineer Francis X. Hursey. The product, QuikClotŽ brand hemostatic agent, is the first in history that rapidly stops severe arterial or venous bleeding outside the surgical setting."

ZettaCore

"... developing ultra-dense, low-power, lower-cost memory chips that have the potential to revolutionize the microelectronics industry."

Zhangyuan Tungsten Co.
Nanoscale tungsten carbide powder.

Zyvex Molecular Nanotechnology research company. Working in the areas of Nanomanipulation, Mechanochemistry, assembler system design, CAD, and others. Interview with James Von Ehr II by John C. Snider

9.4 Seznam 534 nanotehnoloških podjetij po svetovni lokaciji

Seznam 534 nanotehnoloških podjetij po *svetovni lokaciji* *u* in s povezavami na njihovo spletno stran.

(Seznam je bil izdelan s pomočjo mreže Nanotechnology Now,pri iskanju proizvajalcev nano delcev)

ASIA

China | India | Japan | Korea | Malaysia | Singapore

China

Beijing:

Beijing Nano Sunshine Technology Co. Ltd
Nanocor's regional distributor in China

Advanced Battery Technologies
"... develops, manufactures and distributes rechargeable polymer lithium-ion (PLI) batteries"

Jiangxi:

Zhangyuan Tungsten Co.
Nanoscale tungsten carbide powder.

Shenzhen:

Chengyin Technology
Focused on the R&D of nano-structured titanium dioxide in sunscreen, antimicrobial, anti-static and photocatalysis

Shenzhen JINGANGYUAN New Material
Specializes in R&D, manufacture, and marketing of nanodiamond powder and suspension, and their applications. With an annual output of up to10 million carats.

Shenzhen Nanotech Port Co
Research, manufacture, application and sales of carbon nanotubes.

Taiwan:

Genesis Nanotech Corporation
"... produces Nano-scale AlOOH,TiO2 & other ceramic powders and slurries for polishing , coating , & photo-catalyst high-tech industries."

Nano-Infinity Nanotech Co.
"... a specialized manufacturer of nano material and related nanotechnology for health beauty product, including healthy deodorant, body guard, beauty care, nano materials & semi-finished goods etc."

Nano Superlattice Technology
"... focused on research and development and mass production of nano-scale coating technology."

Asia Pacific Fuel Cell Technologies
"... PEM fuel cells with technologies in stack design and manufacture, system integration and metal hydride hydrogen storage."

unnan Province:

21st Century NanoTechnologies
Single-walled carbon nanotubes (SWNT)

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India

Bangalore:
Qtech Nanosystems
"... a 'technology incubation enterprise' focussed on making products based on nanotechnology."

Velbionanotech
"VBN is dedicated to furthering the art, science and practice of nanotechnology, where Biology, Chemistry, Physics and mechanical design converge Molecular scale."

Kolkata:
United Nanotechnologies
"... was established with an aim to cater products based on Nanotechnology for the Indian market."

Japan

Aichi:
Admatechs
"Spherical shape particulates. Admatechs is a joint venture of Toyota Motor Corp., Shin-Etsu Chemical Co., Ltd., Shin-Etsu Quartz Products Co., Ltd., and other firms."

Chiba:

NanoCarrier

"... striving for advancement in the development of new medicines and diagnostician/pathognomy. Integration and development of "Bio and Nano" technology is the ultimate mission and challenge for NanoCarrier."

Osaka:

Fullerene International Corporation (FIC)

"... combines the capabilities of partners Mitsubishi Corporation (MC), Materials and Electrochemical Research Corporation (MER), and Research Corporation Technologies (RCT) in a joint venture to commercialize fullerene materials."

Tokyo:

Alnair Labs

"... established on 29th August 2001 with the aim to provide ultra-short pulse laser systems and solutions based on its unique carbon-nanotubes photonic technology."

Asahi Glass Co.

A global materials and components supplier.

Carbon Nanotech Research Institute

(CNRI) A subsidiary of Mitsui & Co. Research and development of fullerenes and carbon nanotubes which are applicable to next-generation semiconductor, fuel cells, drug remedies for H.I.V., and industrial mass production technology of these materials. About CNRI

Frontier Carbon Corporation

Mitsubishi Corporation and Mitsubishi Chemical Corporation said they will make fullerenes available in quantity beginning in early 2002 under a new joint venture to be known as Frontier Carbon Corporation. Mass production, anticipated to reach 1,500 tons a year by 2004, will permit fullerenes to be bought at prices 10 to 100 times lower than those currently prevailing.

Hitachi High-Technologies

"... established on October 1, 2001. The new company combines the global sales force of the high-tech trading company Nissei Sangyo Co., Ltd., with the world-class technological capabilities of the Instruments Group and the Semiconductor Manufacturing Equipment Group of Hitachi, Ltd."

Mitsui & Co., Ltd. Nanotechnology Department XNRI Group

"At XNRI, we are focused on developing unique technologies that have been enabled by the fusion of a diverse range of disciplines centering around nanotechnology, technologies that will allow us to direct our efforts into research areas related to the environment, energy and medicine."

Nanoten

Nanotechnology Consulting Services, founded by Dr. David Tomanek (of Nanotube fame)

orea

Advanced Nano Products

(ANP) Manufactures nanocrystalline materials and their chemical precursors for coating and powder processing applications.

Advanced Nano Technologies
(ANT) Manufactures of a wide range of ultra fine and nanoscale powders.

ILJIN Nanotech
CNT producer

Nanogist
Applications of nanoscale silver particles. English version coming soon.

NanoMetalGlobal
"... manufacturing nano metal powders and nano powder making equipment."

Nanotech
Nano-composite powders

Samsung
Among others items, makers of nanpowders, and prototype nanotube-based FED (field emission displays).

Seoul:

Hyosung Group
Textile and industrial materials manufacturer, and "maker of nano fiber for health-minded wearers."

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Malaysia

Kuala Lumpur:
Arc Flash Corporation
Photocatalyst coating material

Selangor:
nanopac
"... photo catalytic/functionalized materials, processing technology for powders, coatings and composites, control of surface modification, analysis/evaluation/optimization of materials & processing, and design of Components and Systems (Air purification, Water purification)."

Singapore:

Chartered Semiconductor Manufacturing
Dedicated semiconductor foundry.

Institute of Bioengineering and Nanotechnology (IBN)
"... established to spearhead the advancement of biomedical sciences in Singapore."

NanoMaterials Technology
"... develops and provides technologies for the commercial production of nanosized materials which are applied in industrial markets including the chemical, pharmaceutical, and electronics markets."

AUSTRALIA

Nanotec Pty
"... ready to use product solutions for all kind of surfaces. We offer development services for enterprises which are interested to expand their product lines."

NSW:
Ambri Biosensor Technology
"... pioneering the integration of Biotechnology, Nanotechnology and Electronics."

CAP-XX
"... develops supercapacitors - high-power, high-energy storage devices that enable manufacturers to make smaller, thinner and longer-running products such as mobile phones, PDAs, medical devices, AMRs, compact flash cards, and more." Locations worldwide

Nanostructural Analysis Network Organisation - Major National Research Facility (NANO-MNRF)
"The NANO-MNRF is the peak Australian facility for nanometric analysis of the structure and chemistry of materials in both physical and biological systems."

Queanbeyan:
Dyesol
"To Industrialise and Commercialise Dye Solar Cell Technology."

Queensland:
Nanochem
"NanoChem products in the chemicals and wastewater treatment industries enhance productivity through effective use of new materials with novel properties and superior performance."

Victoria:
CSIRO NanoScience Network
CSIRO is Australia's Commonwealth Scientific and Industrial Research Organisation. The NanoScience Network provides a focal point for CSIRO's nanotechnology activities.

Nanotechnology Victoria
"... a vehicle for optimising benefits to Victoria from advances in nanotechnology and related sciences."

Quantum Precision Instruments
"... patented technology forms the foundation for a family of nanoTrek(TM) nanotechnology MEMS and NEMS sensors having applicability in a wide range of industries: from medicine and bio-technology, through to aviation, aerospace, defence, automotive, seismic, mining and others."

Starpharma
"The Starpharma Group (Starpharma) was established to commercialise novel polyvalent compound technology discovered at the Biomolecular Research Institute in Melbourne, Australia .... comprises a class of high molecular weight, branch-like chemicals (dendrimers) and other polyvalent compounds with demonstrated activity against a broad range of viruses and other human

diseases for which current therapies are inadequate." Teaming with Queensland-based PANBIO and Dr Donald A. Tomalia (the pioneer of dendrimer technology) they have established a new venture to develop products using dendrimer nanotechnology, called **Dendritic Nanotechnologies Limited**. Research facilities are at **The Center for Applied Research and Technology** at **Central Michigan University**, located in Mt. Pleasant, Michigan.

Western Australia:

Advanced Nanotechnology Limited (Advanced Nano)
Manufactures a range of nanopowders and functional products that incorporate nanopowders.

pSivida
"... an Australian listed public company that is committed to the biomedical nanotechnology sectors. It has as its core focus the development of nano-structured porous silicon for multiple potential applications in human and animal healthcare through its UK operating subsidiary, pSiMedica Limited."

NEW ZEALAND

Christchurch
Nano Cluster Devices
"... novel methods for taking clusters of atoms and forming them into electrically conducting wires."

CANADA

Alberta

Edmonton
Micralyne
"A manufacturer of microfabricated and MEMS-based products for leading instrumentation companies worldwide."

Quantiam Technologies
"Develops and commercializes advanced materials based on nanotechnology; manufactures powders, catalysts and coatings for the petrochemical, energy and aerospace industries; provides consulting, technical and research services for characterization of nanomaterials and surfaces; extensive collaboration and seed investment in innovation."

British Columbia

Vancouver:
MIV Therapeutics
"... an advanced stage, research and development company pursuing the commercialization of the next generation of fully biocompatible coatings for stents and other medical devices with the intent of providing healing solutions for cardiovascular disease and other conditions."

West Vancouver:
Advectus Life Sciences
"... an emerging life sciences company focused on the commercialization of a cure for brain cancer.

Advectus holds the exclusive worldwide rights including patents to this nanoparticle-based technology for the delivery of approved cancer fighting drugs across the blood-brain barrier for the treatment of brain tumors."

Ontario

Burlington:

- Gennum

"... a Canadian high technology company that designs, manufactures and markets silicon integrated circuits (ICs), modules and thin-film hybrid microcircuit components for a variety of applications in three target markets."

Hamilton:

- Nanonize Technologies Corp.

"... focusing on the research and development of commercial products based on nanotechnologies in addition to products of nanopowders."

Ottawa:

- Cyrium Technologies

"... developing high-efficiency solar cells, using proprietary breakthrough technology, for the space and terrestrial markets."

- Institute for Microstructural Sciences

"... to provide leadership, in collaboration with Canadian industry and universities, in the development of the strategic base for information technology."

Toronto:

- AMR Technologies

"... develops, manufactures and distributes performance materials."

- C Sixty

"... a private biopharmaceutical company focusing on the discovery and the development of a new class of therapeutics based on the fullerene molecule..."

- Integran Technologies

Nanostructured material technologies.

Tweed:

- Canano Technologies

"We specialize in the mass production of pure nanometals, and to date have produced aluminum, copper, iron, cobalt, indium, selenium, tungsten and copper/gallium."

Québec

Baie D'Urfe:

- American Dye Source

"... is now offering nano materials. These materials can be used for a variety of applications in display devices, security devices and heat reflecting devices."

Boucherville:

- Groupe Minutia

Specializing in nanometric powder technology.

Laval:

- Labopharm

"... international, specialty pharmaceutical company focused on improving existing drugs by incorporating our proprietary, advanced controlled-release technologies. ... also developing novel polymeric, nano-delivery systems for delivery of water-insoluble and poorly bio-available drugs."

Montreal:

- Advanced Powders & Coatings (AP&C)

Wholly-owned by Raymor Industries Inc. "... spherical metal powders."

- Centre for Large Space Structures and Systems (CLS3 Inc.)

"... technologies for large space structures towards the micro devices and systems of the future."

- CLS3 Inc., MEMS for Aerospace

"... information and details related to research and development of MEMS technologies for aerospace applications in Canada ..."

- Nanometrix

"... has developed a unique, innovative, patented and effective process (the MG-1 Process) to structure, organize and assemble molecules and atomic-size particules."

Québec City:

- Nanox

"... mechanochemical synthesis and perovskite formulations for low temperature diesel oxidation catalysts (DOC) and other types of autocatalysts."

Sherbrooke:

- Quantiscript

"... a nanotechnology company developing process solutions aimed at next generation lithography (NGL) for the microelectronics industry."

EUROPE

Austria

Linz:

- NANOIDENT

Organic semiconductor based photonic sensors.

Schwarzenau:

- Metcomb Nanostructures

"With its patented Integrated Nanostructure Control process, Metcomb leverages nanotechnology to create the first aluminum foam that is uniformly consistent, mirroring the way Mother Nature creates organic load-bearing materials, such as wood, bone and coral."

Belgium

Ghent:

- Ablynx

"... a biopharmaceutical company engaged in the discovery and development of Nanobodies™ to treat a range of serious human diseases. Nanobodies™ are a novel class of antibody-derived therapeutic proteins."

Namur:

- Nanocyl

"... exploiting and valorising new discoveries and a strong portfolio of intellectual property developed by Prof. Janos B. Nagy's team at the University of Namur in the field of Carbon Nanotubes."

Seneffe:

- it4ip

"... spin out from the Université Catholique de Louvain (Belgium), dedicated to the development and production of unique templates based on the combination of ion track technology of polymers with templating capabilities."

Cyprus

- Rosseter Holdings Limited

"... a company that specialises in large-scale production of Carbon Nanotubes and related materials."

Denmark

Copenhagen:

- Nanon A/S

"... a world leader in the nanoscale manipulation of "difficult" polymers, such as silicone, with the goal of optimizing performance - without compromising the properties of the base material."

Finland

Lahti:

- Amroy

"Our latest product family is HybtoniteŽ-nanoepoxies. HybtonitesŽ can be used in marine, automotive, wind energy and in many industrial applications."

Joensuu:

- Nanocomp

"... design and manufacture of diffractive optics and microstructures."

Jyväskylä:

- NanoLab Systems

"Our main focus area is Carbon NanoTube based applications where we have created novel modification processes and devices. These processes are widely used by companies in polymer industry where we have made exclusive license agreements with corporations in specific segments."

- Nanoway

"We develop innovative approaches and offer superior solutions for the low temperature community."

France

Cedex:

MEMSCAP

"... a provider of innovative MEMS-based solutions for the design, development and manufacture of telecommunications products."

Clapiers:

Nanoledge

"... designs and develops high-performance and multi-functional materials and fibers out of carbon nanotubes (CNT)."

Grenoble:

Minatec Innovation Center

Centre for Innovation in Micro and Nanotechnology. MINATEC, CEA Leti, INPG, Grenoble, France

Nanopolis

Whether you are a researcher, industrialist or educator involved in the emerging field of nanotechnology, Nanopolis multimedia distributed knowledge network and encyclopedia series provides you a straightforward way to understand the Nanotech world and to be understood within.

Lannion:

Kerdry

Thin films technologies and optical components coatings.

Paris:

Nanotubes Broker

"As a visitor of Nanotubes-broker.com, you are entitled to a 5% price reduction on your nanotubes purchases from the american or european suppliers ..."

Pessac:

Flamel Technologies

"... a recognized world leader in the innovation of delivery systems for small molecule and protein drugs, providing tailored solutions to the biotech and pharmaceutical industries for optimized controlled-release delivery of drugs."

Toulouse:

INPT

Institut National Polytechnique de Toulouse. "We supply, in collaboration with an industrial group, samples of MWNT (10-100g)."

Germany

Baytubes

"As a market- and customer-oriented inventor company, Bayer MaterialScience is working closely with Bayer Technology Services to promote the development of this exciting future technology (nanotubes)."

Aachen:

AMICA

Advanced Micro-electronic Center Aachen "Our research is dedicated to silicon process technology with a strong focus on nanolithography."

Ammersbek:

Ormecon

Commercialized special kinds of conductive polymers ("organic metals") highly engineered nanostructured materials made from organic building blocks.

Berlin:

Capsulution NanoScience AG

"... is a Berlin-based company, which has started with a vision: to create innovative, highly-specialized products by applying its unique LBL-TechnologyŽ to existing and emerging needs in life science developments. The LBL-TechnologyŽ (derived from the term "layer-by-layer") is a high-tech tool for making unique multifunctional nano- and micron-sized capsules which are invisible to the human eye."

MagForce Nanotechnologies AG

Nanotechnology-based cancer therapy

Cologne:

SuNyx

"Functional surfaces with optimised wetting and optical properties are the core technology of SuNyx Surface Nanotechnologies, a recent spin-off of the Bayer Corporation."

Darmstadt:

AQUANOVA German Solubilisate Technologies GmbH

"As a scientifically orientated company AQUANOVA specialises in the development and production of clear, stable, water-free solubilisates of particles with a micelle structure for further processing in cosmetics, skin care products, pharmaceuticals, foodstuffs and nutritional supplements."

SusTech Darmstadt

"... a center of competence for nanotechnology. Consisting of an international team of currently 30 scientists it develops new materials, systems and products. Its location on the campus of the Technical University of Darmstadt makes it possible for our chemists, physicists, engineers and materials scientists to use the adjacent research facilities efficiently."

Dortmund:

NTERA

NSC-Nanosemiconductor-GmbH "... designs and fabricates semiconductor wafers grown by Molecular Beam Epitaxy in (In, Al, Ga) As with Si and C doping elements system using proprietary nanoepitaxial techniques for optoelectronic and microelectronic applications."

Duisburg:

NanoFocus

"... provides measuring solutions that meet the demand for highly accurate measurement of micro- and nanostructures."

Düsseldorf:

Henkel

"We have only just begun to uncover the vast possibilities of this fascinating field (nanotechnology). The first interesting products have been developed, from additives in cosmetics to barrier effects in adhesives, and lubricants for process chemicals."

Engen:

NanoCraft

Detailed investigations with SPM-Techniques, Scanning Tunneling Microscopic analysis; Sample preparation and surface modification; Production of chemically modified tips; Evaluation, analysis and interpretation

Gladbeck:

AlCove Surfaces

Medical device technology using special designed ceramic surfaces made of nanoporous aluminium oxide, applications such as local drug delivery or local brachytherapy. And nanostructured surfaces between 20 nm and 300 nm, changing the reflectivity, adhesion, wettability, and other properties.

Gluecksburg:

Percenta Europe Ltd

A wide range of goods to protect surfaces; sealants and coatings.

Goslar:

Genthe -X- Coatings

"... develops, manufactures and applies nano-coatings to optical substrates enabling transparency even under the toughest conditions - a truly transparent performance."

Hanau-Wolfgang:

Degussa Advanced Nanomaterials

An internal start-up of Degussa - making nanoscaled powders.

Heusweiler:

Nanopool

"The German Ministry of Research and Education promotes the project "Ultra Thin Layers" as being one of seven clearly defined disciplines of nanotechnology. The manufacturing of those ultra thin nano layers is the core competency of nanopool GmbH."

Landsberg:

Starnberger

"... over 40 years experience as supplier of high quality coatings. Our company was one of the first offering high quality fluorocarbon coatings."

Ludwigshafen:

BASF

BASF is one of the world leaders in the chemical industry, and currently produces several nano-

products, such as nanoparticle pigments and nanoscale titanium dioxide particles. See also Nanotechnology at BASF

Magdeburg:

NanoPharm

"... develops novel carrier systems for the treatment of brain tumors and nervous system disorders using biodegradable nanoparticles. Nanosphere drug targeting systems allow any drug to cross the blood-brain barrier."

Mainz:

PlasmaChem

Nano-materials and -powders, detonation-, vacuum-, plasma- and ultra-thin film technologies and their biomedical and technical applications.

Munich:

NanoScape

"... a new enterprise in the field of materials discovery concerned with the design and development of novel, functionalised materials with the potential to open up new processes within the chemical industry."

nanotype

"... will enable next generation evolution in drug development and diagnostics through application of our proprietary C-FIT™ (Congruent Force Intermolecular Test) technology. C-FIT™ unites nanotechnology and biology..."

Süd-Chemie

Makers of NanofilŽ - nanocomposite filler product line for polymer applications.

SUSS MicroTec

manufacturer and supplier of precision microelectronics equipment for the manufacturing and R&D environments.

Rossdorf:

NaWoTec

(nano world technologies) "Numerous international patents on nanolithography with electron beam induced reactions (formation of nano-structures on surfaces) and especially modified high resolution electron beam systems are the basis for successful applications in electronics, nano-analytics, bio-nano physics and micro-optics."

Saarbrücken:

ItN Nanovation

"... main focus on the development, production and commercialisation of products based on nanotechnology."

Nanogate Technologies GmbH

"... concentrating at present on the commercial areas of Surface technology and Ceramic nanotechnology."

Nano-X

"... develops and produces new materials from chemical nanotechnology with multi-functional properties."

Tholey:

- Nano Tech Coatings

Material coatings using the sol-gel process for manufacturing inorganic-organic hybrid polymers.

Gibraltar

- Cool Chips

"... is the future of all cooling, refrigeration, and thermal management. Cool Chips use a revolutionary new thermotunnel technology to deliver up to a projected 70-80% of the maximum (Carnot) theoretical efficiency for heat pumps."

Greece

Athens:

- Acrongenomics

".. a publicly traded Nanobiotechnology company that specializes in the field of research and development of solutions in the fields of Genomics, Proteomics and Diagnostics."

Rio-Patras:

- Nanothinx

"... large-scale, high-yield and low-cost production of carbon nanotubes."

Hungary

Budapest:

- Thales Nanotechnology

A subsidiary of ComGenex, Inc. involved in exploring the use of continuous flow chemistry with nanotechnology in the field of drug discovery.

Ireland

Cork:

- Nanocomms

"... unique IP in the area of design, development and manufacture of polymer micro systems for photonic and life science applications."

Dublin:

- Allegro Technologies

"... a knowledge-based campus company. It has developed outstanding proprietary microdispensing technologies for current and next generation applications in the fields of drug discovery, genomics and analytical/diagnostic instrumentation."

- Elan Drug Delivery

"Our mission will continue to be the provision of drug delivery platforms for new molecules—insoluble compounds, genes, proteins and peptides—that need to be delivery-engineered right from the discovery stage." Drug Delivery Technology NanoCrystalŽ Technology.

- Ntera

A broad-based nanotechnology company with current applications in flat panel displays, medical diagnostic sensors and targeted drug delivery.

Italy

San Vendemiano:

- MechanomadeŽ Ball Milled Nanophased Materials (MBN)

"... produces nanophased powder materials using a high-energy milling process."

Netherlands

Amsterdam:

- Agendia

"... developed high-quality methods, using micro-array genetic profiling, for analyzing tumor samples and mapping the tumor's specific properties."

Arnhem:

- Akzo Nobel

Coatings/Chemicals and Pharmaceuticals

Eindhoven:

- Nanoventure

"... a holding company, predominantly into established, growth oriented enterprises in nanotechnology and adjacent technology fields."

Portugal

Santo Tirso:

- AMT Coatings

"A technological based SME industry which deals with engineering coatings and advanced surface treatments for production of nanomaterials coatings (Electroplating, Electroless Plating, Anodising, PVD, etc.)."

Scotland

Edinburgh:

- Aktina Limited

"Nano-engineered films for creating stable surface structures."

Spain

Bizkaia:

- Labein

Centre for Nanomaterials Applications in Construction (NANOC) "... a recently created unit with in LABEIN and a platform aimed at developing key technological capacities that will enable the Construction Industry to use Nanotechnology as a competitive tool."

Madrid:

- CMP Científica

Europe's first integrated solutions provider for the Nanotechnology Community, specialising in providing Nanotechnology information to the scientific and financial communities; Linking science

& industry through networks of excellence and conferences; Providing expert solutions for high technology and advanced manufacturing companies; Venture Capital funding for nanotechnology startups.

Sweden

Lund:

- Nanofreeze

"... founded in September 2005, as a spin off from research performed at Lund University in the field of thermoelectrics."

- QuNano AB

"... a venture-backed, development-stage nanotechnology company focused on development and commercialization of next generation quantum nanoscale semiconductor materials and devices for the electronics, optoelectronics and sensor markets."

Malmö:

- Obducat

Developer and supplier of technologies and processes for the production and analysis of very fine structures (micro and nano structures).

Switzerland

Aničres:

- NanoLight

Produces a mercury free fluorescent tube, the NanoLamp. Utilizing a cathode "based on Field Emission of electrons from a wire covered with carbon nanotubes."

Liestal:

- NanoSurf

"... main focus is on the research and development of scanning probe microscopes (SPM) and positioning devices with nanometre resolution."

Neuchâtel:

- Colibrys

"... supplier of Micro Electro-Mechanical Systems (MEMS) and components, Micro Optical Electro-Mechanical Systems (MOEMS) and Micro optical components."

- Swiss Center for Electronics and Microtechnology

(CSEM - Centre Suisse d'Electronique et de Microtechnique SA) CSEM is mainly active in the areas of microtechnology, microelectronics and information systems.

Rüschlikon:

- IBM Zurich

The Industry Solutions Lab (ISL) is a joint effort between IBM Research and IBM's Global Industries marketing organization.

Sevelen:

- Schoeller NanoSphere

"NanoSphereŽ finishing technology is revolutionizing the textile industry. Nature's phenomenal "self-cleaning principle" is now also available in textiles." English and German

Sion:

- Mimotec SA

Manufactures customized micromolds and micro-components.

UK

Bristol:

- NanoMagnetics Ltd

"... developing advanced magnetic materials for the information storage industry using its patented protein-based technology. These materials have the potential to replace the magnetic thin film technology used today by the hard disk industry, which is seeking to overcome the approaching physical "superparamagnetic" storage density limit."

Cambridge:

- Accelrys

"... provides software solutions for pharmaceutical and chemical research. Products and processes as diverse as nanotechnology and bulk chemical production can be investigated and improved upon using Materials Studio functionality. "

- Plastic Logic

"... a leading developer of plastic electronics technology. It develops and exploits new manufacturing processes which combine the power of electronics with the pervasiveness of printing."

County Durham:

- Thomas Swan & Co.

"... performance and speciality chemical manufacturer." Carbon Nanomaterials Business

Glasgow:

- Kelvin Nanotechnology

"... created in 1997 to facilitate the commercialisation of the world-class technology and expertise in the Department of Electronics and Electrical Engineering at the University of Glasgow."

Hampshire:

- QinetiQ Nanomaterials Ltd

"QNL is a fully owned subsidiary of the QinetiQ Group, Europe's largest science and technology organisation. Across QinetiQ there are over 150 scientists and engineers working in nanomaterials and nanotechnology. By linking them with a proven manufacturing technology we have been able to make significant progress in addressing the key issue of bulk supply of nanometric material - the essential lifeblood of the technology."

London:

- iCurie Lab Holdings

"... research, development and commercialization of advanced microfluidic and nanofluidic

technologies for use in nanoelectric machines and micro electromechanical (MEMS) systems." (their lab is in Seoul, Korea)

JR Nanotech
"... a healthcare company which promotes the application of nano-silver. We use nano-silver particles as an antibacterial substance to provide effective and complication free treatment for age old healthcare."

Manchester:

Nanoco
High-performance nanoparticles

Nanoco Technologies
"... develops and manufactures fluorescent nano-crystals from semi-conductor and metallic materials known as quantum dots."

Newcastle Upon Tyne:

Orla Protein Technologies
"... a bio-nanotechnology company integrating biological systems and physical devices through engineered protein interfaces."

Oxford:

Oxford Nanotechnology
A research and development company based in Oxford, U.K. Our research specialty is into the use of ion beams to create nanostructures, but we also have interests in nano-scale electronic architecture, quantum computing and other nanotechnology research. We are currently looking to expand our operations, and to employ a number of staff research scientists.

Oxfordshire:

Oxonica
"... engaged in building a portfolio of in-house developed new product opportunities and commercialising IPR that has been researched within the Engineering Science and Biochemistry Departments of The University of Oxford."

P2i
"P2i Ltd's plasma surface enhancement process is a 21st century technology that gives everyday products extraordinary performance levels of oil and water repellency."

Tetronics
"... a wide range of technologies for the production and processing of powders in general and for nanopowder production specifically. In addition there are a number of processes involving carbon products, including graphite, carbon black and diamond production."

Southampton:

Nanotecture
A materials science company that has developed a platform technology based on nanoscale, porous lattices. The company's first application is energy storage for batteries and supercapacitors.

Surrey:

Nanotech Semiconductor

"... a fabless chip company, designing and supplying Driver and Receiver ICs for the fiber-optics communications industry."

Wrexham:

Micro Materials

Nanoindentation, Scratch Testing and Impact Testing

Wales

Cardiff:

metaFAB

"metaFAB offers innovative, high-level solutions based MicroNanoTechnology convergence. metaFAB is a dynamic component of the UK DTI MicroNanoTechnology Network. metaFAB integrates the resources of diverse research centres and supply chain partners."

Q Chip

"... a precision particle engineering company with a unique microfluidic technology enabling sophisticated manufacture of micro- and nano-particles for the high value added manufacturing industries of pharmaceutical, food and cosmetics."

MIDDLE EAST

Israel

NutraLease

"The Technology is a patent pending called Nano-sized Self-assembled Liquid Structures (NSSL) and is related to the nano-sized vehicles that are used as vehicles to targeted compounds (such as nutraceuticals and drugs)."

Bet Shemesh:

Sol-Gel Technologies

"... proprietary platform nanotechnology is an innovative concept, that involves the encapsulation, at room temperature, of active ingredients in micro- and nano-sized glass (silica) matrices as well as nanospheres utilizing a chemical process called sol-gel."

Caesarea:

NanoPowders Industries

"... metal powders on a production scale to meet the needs of present and future markets."

Jerusalem:

Nanolayers

"Nanolayers is the commercial name chosen for Dr. Shlomo Yitzchaik's Molecular Layer Epitaxy (MLE) technology -- a breakthrough, patented nanotechnology from his laboratory at The Hebrew University of Jerusalem. Nanolayers is a basic enabling technology for semiconductor, microelectronic, materials, bioelectronics, telecommunications and multiple other industries that constitute central growth markets in the upcoming decade."

Migdal Ha'Emek:

- Nano-Size

"... specialize in research, development and production of exceptionally high specific surface area powders, nanoparticle dispersions and ultra fine grinding."

Ness Ziona:

- SoluBest

"... using advanced polymer formulations to prepare nanotransporters for drugs having delivery or compliance insufficiencies."

Or-Yehuda:

- Docoop Technologies

"*Neowater*™, a novel proprietary water-based nanotechnology, is a broad enabling platform upon which research, diagnostics, biotech and pharma companies can obtain disruptive price-performance results, yet with a graceful implementation."

Rehovot:

- R&D for ApNano Materials

"... commercializes nanospheres and nanotubes of inorganic compounds discovered at the Weizmann Institute of Science in Rehovot, Israel. These materials are used in microelectronic, semiconductor, aerospace, lubricant and metal working markets." See funding article for more information.

RUSSIA

Moscow:

- NanoCarbLab

(NCL) "A nanotechnology division of MedChemLabs Inc. (MCL). Main purpose is supplying carbon nanotubes of highest grades of purity and developing methods of bulk production."

- Invest Technologies

"Our enterprise takes part in the activity of Russian Committee 'Ultrafine (nano) materials' for production, research of properties and application of UFP. We also cooperate with leading scientific institutes, conducting studies of nanocrystal materials."

SOUTH AMERICA

Brazil

Sao Paulo:

- Center for Automation in Nanobiotech (CAN)

"... focuses on investigation of new paradigms for innovation in systems and automation design. CAN's main thrust and aim is the development of practical and useful nanobiotechnology systems and devices that may benefit people around the globe with biomedical engineering advances."

Mexico

Monterrey:

- NanoMerk

"... distribute and commercialize high technology products that offer a different and innovative solution to everything available in the market."

USA

Alabama | Alaska | Arizona | Arkansas | California | Colorado | Connecticut | Delaware | Florida | Georgia | Hawaii | Idaho | Illinois | Indiana | Iowa | Kansas | Kentucky | Louisiana | Maine | Maryland | Massachusetts | Michigan | Minnesota | Mississippi | Missouri | Montana | Nebraska | North Carolina | North Dakota | Nevada | New Hampshire | New Jersey | New Mexico | New York | Ohio | Oklahoma | Oregon | Pennsylvania | Rhode Island | South Carolina | South Dakota | Tennessee | Texas | Utah | Vermont | Virginia | Washington | Washington, D.C. | West Virginia | Wisconsin | Wyoming

Some of these links will not work as there are some states with no companies, for now.

Alabama

Huntsville:

- MEMS Optical

Supplier and manufacturer of both refractive (microlens arrays) and diffractive (beam shapers, beam splitters, etc.) micro optics, and of MEMS devices such as scanning tilt micro mirrors and deformable mirrors.

Arizona

Scottsdale:

- Bourne Research

"... market intelligence, with a specialized focus on MEMS (MicroElectroMechanical Systems), Nanotechnology, and the convergence of both."

Tempe:

- SDCmaterials

"... mission is to commercialize new technologies that dramatically reduce the cycle time and the cost of successful discovery of new materials."

Tucson:

- Focal Point Microsystems

FP Micro is currently developing a state-of-the-art, free-form fabrication system for 3D objects that utilizes proprietary patterning materials. This integrated bench-top unit will be convenient, user-friendly, environmentally friendly, and capable of prototyping and producing 3D micro and nanoscale structures, components, and devices.

- ImaRx Therapeutics

"We believe that localized, site-specific, NanoInvasive™ medicine will provide benefit to patients and society by lowering costs, minimizing pain, and reducing the length of hospital stays and

recovery time, while providing improved patient outcomes."

Materials and Electrochemical Research Corporation
"Devoted to high-technology materials and electrochemical research with emphasis on advanced composites, powders, coatings and fullerenes ..."

Tailored Materials Corporation (TMC)
"... an emerging manufacturer of ultra-pure, carbon Double-Wall Nanotubes (DWNT) for Field Emission Displays and other devices."

Arkansas

Fayetteville:
NanoMech
"... mission is to provide innovative nanostructured coatings, related manufacturing processes and systems for a broad range of applications that improve the quality of life."

Nanomaterials and Nanofabrication Laboratories (NN-Labs)
"... production, processing and applications of semiconductor nanocrystals and dedron ligands."

California

Aliso Viejo:
Nanosciences
"... providing the most advanced products, systems, & services for nanodevice, MEMS, BioMEMS and MST applications."

Antioch:
NanoMuscle
"... designs and manufactures advanced motion technologies for use in a wide range of consumer devices. Our breakthrough products displace conventional electromagnetic motors and solenoids, and for the first time provide miniature, affordable motion."

Carlsbad:
DuPont Air Products Nanomaterials
A joint venture between DuPont and Air Products and Chemicals, Inc. "Developing, manufacturing, marketing and selling polishing slurries for electronic precision polishing and chemical mechanical planarization (CMP) processes used in the semiconductor industry."

JMAR
"... develops, manufactures and markets a wide range of precision measurement, process control and laser manufacturing systems to enable its customers to produce smaller, faster, more powerful and less expensive precision microelectronic products. JMAR also provides custom semiconductor products and is a leading developer of advanced lithography sources for the production of higher performance circuits for future electronic systems."

PowerMetal Technologies
A provider of electrodeposition and product engineering services for nanometals in the consumer and sporting goods industries.

Cerritos:

- Omni-Lite Industries

"... one of the world's leading developers of precision components utilizing advanced composite materials and computer-controlled cold forging techniques."

City of Industry:

- Blue Pacific

"... a leader in new flavor technology."

Costa Mesa:

- QuantumSphere

"... a leading manufacturer of metallic nanopowders for aerospace, defense, energy, and other markets."

- Tekon

"... surface care protection for your glass, metal, stone, granite, plexiglass, vinyl and travertine surfaces."

Emeryville:

- Nanomix

(formerly Covalent Materials Inc.) New materials are designed, synthesized and characterized at the nanometer scale for a myriad of applications in industries ranging from electronics to biotechnology.

Fremont:

- Active Optical Networks

"... advanced MEMS-based active optical components and subsystems to enhance the performance and wavelength management capabilities of optical networks."

- Colossal Storage Corp.

Developing a rewritable volume holographic optical mass data nanophotonic storage device.

- Intematix

"Intematix methodology for Materials Discovery utilizes the latest in top-down design and rapid prototyping."

- NanoGram Devices

"... founded in 2002 as a spin-out from NeoPhotonics Corporation, develops novel medical device applications based on its proven and patented laser-based nanomaterials synthesis process. The company's products include patented nanomaterial-based medical power sources that enable dramatically smaller, longer lifetime medical devices with superior performance."

- NeoPhotonics

"... designs, manufactures and markets planar optical components through the deposition of nanoscale light enhancing materials."

Hawthorne:

Cereplast

"... the developer and manufacturer of a breakthrough new material which is used as a substitute for conventional, petroleum-based plastics."

Hayward:

Quantum Dot Corporation

Develops and sells novel solutions to accelerate the discovery and development of functionally validated novel drug targets at the cellular level.

Huntington Beach:

Hybrid Plastics

"... manufactures nanostructured chemicals for the preparation of nanocomposite materials. Polyhedral Oligomeric Silsesquioxane (POSS) is a silicon based material that is intermediate in composition between silica and silicone."

Los Angeles:

Abraxis Oncology

"The proprietary drug division of American Pharmaceutical Partners. ... dedicated to improving treatments for patients with cancer." Maker of Abraxane - paclitaxel protein-bound nano-particles for injectable suspension.

American Elements

"... a world leader in commercializing developments in materials science."

Los Jolla:

Seashell Technology

"... nanoparticles and nanostructured materials for academic research, development projects and for industrial processes."

Menlo Park:

Nanoscale Combinatorial Synthesis Inc.

(Nanosyn) "... focused on developing integrated technologies for miniaturized ("nanoscale") to milligram scale combinatorial synthesis. ... We produce combinatorial libraries with unique design features and provide access to an existing compound collection approaching 100,000 individually purified and analytically characterized small molecules for drug discovery."

Nanostellar

"... a Menlo Park-based Nano-Composite Material company that develops highly efficient Platinum Nano-Composite Catalyst solutions."

Rolltronics

"... a Silicon Valley technology company, is developing roll-to-roll (R2R) manufacturing processes that will enable the production of electronic devices with dramatically lower costs and improved product features: thin, light, flexible, durable, affordable, faster to prototype and faster to market."

Monterey:

Interface Sciences Corporation

"... commercialization of the extraordinary patented SAMs technology."

Morgan Hill:

Alien Technology

"... developed and holds exclusive patent rights to, a manufacturing technology that will dramatically reduce the manufacturing cost of a variety of electronic devices. The technology, called Fluidic Self-Assembly (FSA™), permits the efficient assembly of Integrated Circuits into a variety of substrates, from glass to flexible plastic."

Mountain View:

Actel Corp.

"... award winning single-chip FPGA solutions, including FPGAs based on antifuse and Flash technologies, high-performance intellectual property (IP) cores, integrated software development tools, programming tools, debug and demo boards, and design services."

Nanoplex Technologies

"... focuses on developing and commercializing products based on novel metal nanoparticles and nanoparticle-based surfaces."

SurroMed

"... focused on applying its phenotyping technologies to accelerate the pharmaceutical discovery and development process and enable the precise diagnosis and personalized treatment of disease."

Monterey Park:

GeneFluidics

"... a bionanotechnology company founded in November 2000 by leading scientists and researchers from UCLA. The Company has developed a technology platform capable of making highly manufacturable, cutting-edge electrochemical molecular analysis devices using integrated nanotechnology, plastic micro electromechanical systems (MEMS) and microfluidics."

Newport Beach:

NanoLife

"NanoLife Holdings has focused its commercial efforts on nanotechnology since 1999. Our thrust has always been focused on more efficient releases of energy in a reaction between nano-particles." (Corporate Office)

Northridge:

Chemat Technology

"... has established itself as a world leader in the development of advanced materials via sol-gel technologies."

Oakland:

Nanochip Inc.

Design of Micro-Electro-Mechanical Systems (MEMS) silicon memory.

Oxnard:

Catalytic Solutions

"... manufactures and delivers a break-through proprietary technology that significantly improves the performance and reduces the cost of catalytic converters."

Palo Alto:

- Agilent

"Agilent Technologies is on the leading edge of nearly every major trend in communications and life sciences. From optical and wireless communications to disease and discovery research, Agilent delivers product and technology innovations that benefit millions of people around the world."

- Hewlett-Packard

- HP Labs - Quantum Science Research

- Medical Murray

"Medical Murray has extensive experience in the injection molding and development of nanoscaled plastic parts."

- Molecular Nanosystems

"... engaged in research, development and production of nanotube-oriented products and systems using leading-edge nanotechnologies."

- Nanosolar

"... focused on bringing to market a new generation of very-low-cost solar electricity cells, which are light-weight, flexible, and easily adjustable in shape. Based on flexible plastics, solution coating, and self-assembling nanostructures, Nanosolar's technology combines advanced nanostructural control with simple production processes to enable efficient very-low-cost solar cells."

- Nanosys

A development stage company focused on building nanotechnology-enabled systems. Larry Bock - president and CEO. They have an exclusive licensing arrangement with Harvard University for a portfolio of fundamental intellectual property, including nanowires, which were developed by Harvard Professor Charles Lieber.

- SpeciGen

"... intends to develop the next generation of targeted drug delivery and imaging agents using proprietary, nano-scale protein cage architectures."

- SurgRx

Smart Electrode Technology™ - Nanoscale RF control for tissue welding.

- Targesome

"... a drug development and drug delivery company utilizing its proprietary nanoparticle technology to produce novel, efficacious drugs with improved properties. New or existing drugs, either antibodies or small molecules, can be attached to the nanoparticle to develop a new class of therapeutic agents."

- Xerox Palo Alto Research Center

(PARC) Founded in 1970, PARC transformed computing with inventions such as the graphic user

interface, client/server architecture, laser printing and Ethernet. Current activities are focused on Networks and Documents, Smart Matter and Knowledge Ecologies.

Pasadena:

Aonex Technologies

A subsidiary of Arrowhead Research. "... focused on applying its technology to next-generation solar cells. Ultimately, the company seeks to enable devices with optical, logical, and amplification features on a single substrate."

Insert Therapeutics

A subsidiary of Arrowhead Research. "... expanding the frontiers of drug delivery technology. In contrast to existing, FDA-approved methods, the proprietary technologies of Insert Therapeutics provide for the intracellular delivery of a broad range of therapeutics."

Luxtera

"... developing breakthrough photonics products. The company's technology is rooted in Caltech developments in the field of nanophotonics: optical structures an order of magnitude smaller than those traditionally used in integrated optical devices."

Nanotechnica

A subsidiary of Arrowhead Research. "... seeks to develop a variety of nanoscale devices and systems."

Nanostream

"We create microfluidics chips to serve our customers' needs in small-scale fluid manipulation. Using a unique modular approach, Nanostream's technology helps automate and miniaturize fluid-handling. This approach also allows for extremely fast prototyping, seamless scale-up and mass customization with turnaround time in days."

Redwood City:

Lumiphore

"... develops and markets biological detection systems based on luminescent lanthanide complexes, which provide a unique combination of sensitivity, reliability, flexibility and high throughput."

Riverside:

Carbon Solutions Inc.

Carbon Solutions Inc. is involved in the chemistry, applications and commercialization of single-walled carbon nanotubes (SWNT).

San Clemente:

DFI

"DFI's nanotechnology is applicable to most surfaces containing silica (silicon dioxide) such as glass, ceramic tile, porcelain, and granite."

San Dimas:

Greenmillennium

"... a photo-catalyst material and solution provider in the domain of environmental coating services and business integration."

San Diego:

Nanogen

Integrates advanced microelectronics and molecular biology.

Nanotrope

"... founded in 2004 to commercialize nanoscale droplet technology being developed at the University of California, Irvine. The droplet technology provides high-precision, digital control of biochemical processes at the nanoscale."

OMM

"developed the technology of optical MEMS .... also incorporated two other core competencies: optoelectronics packaging and automated manufacturing of photonic switching subsystems."

San Francisco:

Optiva

"Benefiting from over two decades of successful large-scale research in supramolecular engineering, Optiva is the first to develop a commercial mass-production process optical self-assembling materials ("nanomaterials"). Optiva's first family of thin crystal films (TCF™) products will target the flat panel display industry, offering significant cost and performance advantages over traditional polarizer film alternatives. "

San Jose:

Applied MicroStructures

Surface chemistry and modification.

California Molecular Electronics Corporation

"... committed to profitably invent, acquire, assimilate, and utilize intellectual property in the field of molecular electronics to develop and sell quality products based on molecular electronics technology ..."

Cavendish Kinetics

"... focuses on the development of CMOS compatible MEMS process modules, the design and modeling of MEMS devices and subsequently providing these two combined (process module and design module) as an IP (Intellectual Property) package for customers to use in numerous different application areas."

cDream Corporation ("cDream")

"... a fabless display company, founded to develop and design the next evolution of flat panel displays ("FPDs") using our proprietary carbon-nano tube technology, replacing and superceding displays based on cathode ray tube ("CRTs"), thin film transistor liquid crystal ("TFT-LCDs"), plasma display panels ("PDPs") and organic light emitting diodes ("OLEDs")."

EnviroSystems

"... products include a line of hospital-grade cleansing and disinfecting liquids and wipes that reduce the spread of infectious disease without adverse effects to people, equipment or the environment."

Fluidigm

"... provides a unique solution through fluidics at the nano-scale, using palm-sized devices with

integrated channels and valves."

- IBM Almaden Visualization Lab

- Kainos Energy Corporation

"... has adapted revolutionary nanomaterials processing technologies to fuel cell manufacturing to achieve: lowest cost, lower operating temperature, highest performance and reliability in solid oxide fuel cells, interconnects and stacks."

- Komag

"... supplier of thin-film disks, the primary high-capacity storage medium for digital data in computers and consumer appliances."

- MEMSCAP

"... a provider of innovative MEMS-based solutions for the design, development and manufacture of telecommunications products."

- NanoGram

"... a developer and licensor of core process technology enabling the manufacture of unique nanoscale compositions for optical, electronic, and energy storage applications and products. The company has developed extensive intellectual property that is expanding the boundaries of nanomaterials technologies by enabling the development and manufacturing of new generations of materials, devices, components and applications."

Santa Barbara:

- NanoDevices

"... leverages MEMS fabrication to enhance precision nanoscale metrology and to build a foundation in nanotechnology."

Santa Clara:

- Affymetrix

GeneChip(R) technology has become the industry standard in molecular biology research.

- Ahwahnee

"... a leader in the mass production of Carbon Nanotubes (CNTs), creates high-energy, long-lasting and cost-effective CNT applications for a variety of industries."

- Applied Materials

"... supplier of products and services to the global semiconductor industry."

- Intel

"Intel supplies the computing and communications industries with chips, boards, systems, and software building blocks that are the "ingredients" of computers, servers and networking and communications products." "Intel is behind everything from the fastest processor in the world to the cables that power high-speed Internet."

- Matrix Semiconductor

Matrix has developed and patented the technology to build 3-dimensional memory by stacking

memory arrays vertically.

Miasolé
"... manufactures the first solar technology inexpensive and plentiful enough to make solar power practical for large-scale use."

Santa Monica:
RAND
"RAND (a contraction of the term "research and development") is the first organization to be called a "think tank." ... job is to help improve policy and decisionmaking through research and analysis."

Santa Rosa:
Quantum Polymer Technologies
Self-assembling polymer nanowires.

Scotts Valley:
Seagate Technology
Storage Products

Sunnyvale:
Advanced Micro Devices
Microprocessor Solutions

NanoConduction Inc.

Sunny Valley:
Powdermet Inc.
"Specializes in modifying powder and particulate surfaces through applying metal and ceramic coatings onto particulate matrices. We design, develop, and manufacture metal and ceramic nanoengineered fine powders and particulates using fluidized bed surface modification technology."

Thousand Oaks:
Rockwell Scientific
"Rockwell Scientific is an independent, privately owned high technology enterprise with unique technical strengths in electronics, imaging, optics, materials, and information science. Its range of activities includes contract research and development services for the U.S. government and private sector companies, as well as commercialization of select technologies through licensing and the development, manufacturing, and sales of high value products closely related to its R&D efforts."

Tustin:
Pacific Fuel Cell
"... leader in the development of carbon nanotube-based membrane electrode assemblies (MEA's)."

Valencia:
Enable IPC
"... engaged in the development of a new battery technology that combines the best of thin films and nanotechnology."

Vista:

- Applied Membranes

"... a manufacturer and distributor for Reverse Osmosis Membranes, RO Systems and Components, both commercial and residential."

Colorado

Broomfield:

- ALD NanoSolutions

"... commercialization strategy is founded on the assertion that new materials will be designed rather than discovered. The compelling opportunity is to identify and synthesize a new set of composite materials which are comprised of common substrates coated with specific material."

Denver:

- NanoPierce

- ZettaCore

"... developing ultra-dense, low-power, lower-cost memory chips that have the potential to revolutionize the microelectronics industry."

Golden:

- Isonics

Advanced materials

Lakewood:

- Programmable Matter Corporation

"... a research corporation based in Lakewood, Colorado. PMC was formed for the express purpose of exploring and developing dynamically configurable ismart materials and the technology associated with them."

Longmont:

- InPhase Technologies

"... next generation in data storage that stores millions of pages of information on a disk that fits in the palm of your hand."

- Nanomaterials Research LLC

"... involved in the research, development, and manufacture of gas sensors, electronic components, and unique microfabricated devices (e.g., ceramic MEMS)."

- NanoProducts Corporation

(formerly NanoEnergy Corp.) "... supplier of nanoscale powders and products derived from these powders. ... employ patented technologies to produce nanoscale particles (nanotechnology building blocks), which are currently being manufactured in commercial volumes."

Connecticut

Dayville:

- Foster Corporation

Specialty thermoplastic compounding materials and polymers.

Fairfield:

GE Advanced Materials

"... a world leader in providing material solutions through engineering thermoplastics, silicon-based products and technology platforms, and fused quartz and ceramics." (Headquarters)

Farmington:

Inframat

"An emerging technology company with a mission to develop a variety of materials to improve performance and extend the life of components used throughout the global infrastructure."

US NanoCorp

(USN) "... was incorporated April 1, 1996, as a vehicle to identify, develop, and commercialize value-added products in the field of energy storage and energy conversion devices which exploit the extraordinary properties of nanostructured materials."

Norwalk:

mPhase Technologies

"... has entered into a broad sales, marketing and development partnership with Lucent Bell Laboratories to commercialize nanotechnology for new batteries."

Wallingford:

Z-Medica

"... launched in January of 2002 to market an amazing medical product invented by its co-founder, scientist and former NASA team engineer Francis X. Hursey. The product, QuikClotŽ brand hemostatic agent, is the first in history that rapidly stops severe arterial or venous bleeding outside the surgical setting."

West Haven:

NanoViricides

"We believe that nanoviricides are the next great advance in medicine."

Delaware

Newark:

ANP Technologies

"... develop cutting-edge technology platforms at the nano/bio interface and apply them in market sectors such as diagnostics/biodetection, protein/drug discovery, therapeutics, chem/bio defense, and homeland security."

NanoSelect

"... a nanotechnology company developing chemical and biological sensors to monitor the quality and safety of our municipal water supply systems."

New Castle:

DSM Somos

Rapid prototyping materials, incorporating ceramic nano-particles.

Wilmington:

DuPont Titanium Technologies

"... dedicated to creating greater, more rewarding value for the coatings, paper, plastics, specialties and minerals markets through service, brand, and product." Also Mississauga, Ontario, Canada.

PSI-TEC Corporation

"... a developmental stage company that engineers next-generation electro-optic plastics.

Florida

Alachua:

Nanotherapeutics

"... has made new discoveries in the area of nanotechnology and is applying them to the development of novel drug therapies." As of July 5, 2002 Nanosphere and Nanocoat have merged to form Nanotherapeutics, Inc.

Boca Raton:

NanoBlox

"... develops proprietary products and processes based on a new phase of carbon produced in accordance with NanoBlox patent(s). The building block for the company's technology is a 5 nanometer diameter, sp3 carbon, nanodiamond particle with a chemically tunable surface."

Coral Gables:

Radiation Shield Technologies (RST)

"... proud to offer Demron(TM), the new standard in personal radiation protection. This revolutionary technology is currently produced as full body suits, gloves and boots."

Delray Beach:

Rave

"... a semiconductor equipment manufacturing company capitalizing on its proprietary nanomachining technology which takes advantage of developments in Atomic Force Microscopy, cantilever and Nanobit technology and 3D imaging software and their collective application to critical nanomachining solutions for the high technology marketplace."

Ft. Lauderdale:

NanoEner

A wholly owned subsidiary of Ener1. "... formed to develop and market advanced nanomaterials and nanotechnologies. NanoEner's proprietary technologies enable unprecedented speed and control in synthesis and deposition of nanomaterials for a wide range of applications."

Miami:

Melstream Industries

"Through experience in the industrial and commercial water conditioning sector we offer environmentally safe media for numerous applications."

Miami:

Dais Analytic Corporation

"... a nanotechnology polymer materials company. We design and commercialize new materials that exceed the limits of conventional materials."

Odessa:

Argonide

A resource manufacturer for high purity nanoparticles, nanoscale ceramic fiber materials, and custom alloys.

Tampa:

NanobacLabs

"We are deeply involved in research and medical nanotechnology involving infection by a newly discovered pleomorphic human pathogen known as Nanobacterium sanguineum. We are working with academic researchers throughout the world to develop medical therapies that eradicate the diseases associated with these nanobacteria."

Georgia

Atlanta:

*n*Gimat Co.

"An intellectual property company and a manufacturer of engineered nanomaterials in the following areas: nanopowders, thin film coatings, and devices."

Idaho

Osburn:

Atlas Mining

"Halloysite is a high-value clay that sells for more than $400 per ton. Its fine particle size enables halloysite to be used extensively as a suspension agent in glaze preparations. The purity of the clay and the low iron and titania content result in ceramic ware with exceptional whiteness and translucency."

Illinois

Arlington Heights:

Nanocor

"Nanocor is a new operating subsidiary of AMCOL International Corporation. We are the largest global supplier of nanoclays specifically designed for plastic nanocomposites."

Chicago:

Advanced Diamond Technologies

(ADT) "An early-stage company commercializing a patented technique for making thin films of nanocrystalline diamond. This novel material, which we call Ultrananocrystalline diamond (UNCD), is a form of natural diamond-not a diamond-like compound. UNCD possesses the material properties of natural diamond in thin film form."

NanoInk

"... in business to commercialize the process known as dip pen nanolithography™, or DPN™. We have developed a platform process for nanotechnology that enables our customers and partners to create revolutionary new products and services using a molecular "bottom-up" approach to nanofabrication."

Evanston:

Applied Thin Films

(ATFI) "An advanced materials company developing thin film technologies to serve defense, energy, aerospace, and other industrial needs."

Romeoville:

Nanophase Technologies Corporation

"... a leader in solving product problems through its patented and proprietary nanocrystalline technology."

Northbrook:

Nanosphere Inc.

"... a privately-held life-sciences company located just outside of Chicago, Illinois. Our proprietary technology uses the unique properties of nanoparticles. We have developed a comprehensive system for detecting bio-molecules such as nucleic acids and proteins. Nanosphere, Inc. will become the global standard for molecular diagnostics."

Indiana

Indianapolis:

MicroTechNano Inc.

Distributes high quality nanotube materials.

Iowa

Ames:

BioForce Nanosciences

"... developer of ultra-miniaturized nanoarray technologies for solid-phase, high-throughput biomolecular analysis."

Kansas

Manattan:

Nanoscale Materials Inc.

(formerly Nantek, Inc.) An advanced materials company founded in 1995 to develop and commercialize reactive nanoparticles (RNPs) and other related technologies.

Kentucky

Lexington:

CarboLex

Manufacturers of single-walled carbon nanotubes (SWNT).

Louisiana

New Orleans:

NanoPrism Technologies

"... a platform of patented technologies and proprietary know-how to manufacture and commercialize various nanomaterials with superior performance attributes."

Maryland

Baltimore:

Reactive NanoTechnologies

(RNT) "In 1994 Dr. Tim Weihs (now a professor in Johns Hopkins University Materials Science and Engineering Department) and Dr. Troy Barbee of Lawrence Livermore National Laboratory made a groundbreaking discovery that held the promise of changing the way many materials are held together....Weihs and Barbee patented their invention in 1996, and set to the lengthy task of making these foils ready to manufacture. In this effort they are joined by Professor Omar Knio, who is spearheading the computational modeling effort that will eventually lead to optimizing the foil's design."

Rockville:

CytImmune

"... is developing a pipeline of multifunctional, next-generation therapeutics, binding known anti-cancer agents - whose toxicities currently prevent or severely limit clinical use - to its patented colloidal gold tumor-targeting nanotechnology."

Massachusetts

Ashland:

AMBIT Corporation

"... developer of new and enabling technologies in a variety of fields where rapid commercialization is taking place."

Nyacol

" We specialize in colloidal dispersions of inorganic oxides and powders prepared from these dispersions. We use nano particle technology to create these inorganic metal oxides and organic based silica sols that are largely used as flame retardants, abrasion resistance additives and as binders for catalysts, refractories and ceramic fibers."

Boston:

Cabot Corporation

"... our core businesses: carbon black, fumed metal oxides and tantalum. We've also found and developed them into new businesses: inkjet colorants, NanogelŽ and specialty fluids."

Brighton:

NanoLab

"... convert research ideas into marketable nano-technologies."

Burlington:

Standard MEMS

"... the largest independent high-volume manufacturer of Micro Electro Mechanical Systems (MEMS) for high technology markets."

Cambridge:

3DM Inc.

"PuraMatrix™, 3DM's innovative and award-winning family of biocompatible hydrogels ... nano-

scale properties, synthetic origin, rigorously-tested biocompatability, stability and ease-of-use yield superior cell cultures, with applications in drug discovery, cancer and cell biology, toxicity screening, stem cell therapeutics and tissue engineering."

Advanced Magnetics
"... a developer of superparamagnetic iron oxide nanoparticles used in pharmaceutical products."

Cambrios Technologies
"... mission is to use biological technology to transform the way commercial electronic products are made, expand their impact, and reduce their environmental cost. Cambrios was formed in 2003 to develop commercial applications from the directed-evolution technology invented by the company's founders, Dr. Angela Belcher of MIT and her longtime collaborator, Dr. Evelyn Hu of the University of California at Santa Barbara."

Hyperion Catalysis International
Carbon nanotube development and commercialization.

NSTI Nano Science and Technology Institute "... a leading, global nanotechnology consultancy. Through its knowledge network, NSTI offers high-value services powered by a unique network of established high-level and long-term relationships with leaders in the nascent fields of nanotechnology."

Chelmsford:
Triton BioSystems
"... a development-stage company focused on the discovery and development of non-invasive targeted therapeutics that use heat to treat cancer and other life threatening and debilitating diseases." Currently working on pre-clinical product development of their Targeted Nano-Therapeutics system for advanced breast cancer.

Triton Systems
"... a fast growing materials company located just north of Boston. We provide our customers with unique materials solutions." Including polymers (e.g., polyolefins, polyesters, polyetherimides) that are enhanced by adding specialty nanometer sized particles (1x10-9 m) into the polymer matrix.

Franklin:
Eikos
"... develops unique Carbon Nanotube Formulations for Coatings. We also develop coating methods that allow the conversion of those formulations into highly differentiated products for the commercial displays market and for a wide range of military applications."

Holliston:
Catalytic Materials LLC
"Incorporated in 1995. Leaders on the architecture and design of carbon nanostructured materials including graphite nanofibers and carbon nanotubes."

Hudson:
Holographix
"... state-of-the-art recording, replication, testing, and thin-film coating laboratories."

Lowell:

- Konarka Technologies

"... dedicated to the development and commercialization of solutions for portable and distributed power needs based on photovoltaic products... ... The core of the dye-sensitized technology consists of *nanometer-scale crystals* of TiO2 semiconductor coated with a monolayer of light-absorbing dye and embedded in an electrolyte between the front and back electrical contacts."

Medford:

- Evolved Nanomaterial Sciences

"... an advanced materials company dedicated to the discovery, fabrication and integration of biopolymers into a variety of high-margin applications."

Newton:

- GEO-CENTERS

"GEO-CENTERS supports the U.S. Naval Research Laboratory (NRL) in developing nanoscience and integrating nanotechnology into usable systems."

North Andover:

- Intelligent MEMS Design

Primarily focused on MEMS, they also "project market demands, trends and forecasts based on current and potential future global markets for nanotechnology, and provide patent and IP related services." Also located in Ottawa, Ontario, Canada.

Northborough:

- Aspen Aerogels

"Using patented technology, Spaceloft and Pyrogel materials combine a silica aerogel with reinforcing fibers to deliver proven thermal performance in the most efficient insulation available."

Taunton:

- Kopin

"... patented Wafer-Engineering™ technology in which nanotechnology is applied to semiconductor materials."

Wakefield:

- Nucryst

Noble metal nanocrystalline pharmaceutical and medical device technologies.

Waltham:

- engeneOS

"... will carry out technology and product development to design and build programmable Biomolecular Devices consisting of hybrid natural/non-natural materials addressing a broad range of commercial applications."

Watertown:

- A123 Systems

"... developer of a new generation of Lithium-Ion batteries that revolutionizes the way manufacturers design high power products. Founded in 2001, A123Systems' proprietary nanoscale electrode technology is built on initial developments from Massachusetts Institute of Technology.

QD Vision
"... quantum-dot materials advancements and manufacturing process development for the next-generation of displays."

Westborough:
American Superconductor
"... supplier of dynamic reactive power grid stabilization products and the world's principal vendor of high temperature superconductor (HTS) wire and large rotating superconductor machinery."

Westwood:
Nano-C
"... has developed the leading technology for the manufacture of commercial scale, high-purity fullerenes and other nanoscale fullerenic materials."

Wilmington:
Corning IntelliSense
MEMS design, development, manufacturing and CAD for MEMS software for telecommunications, life sciences and microinstrumentation. A subsidiary of Corning.

Koch Membrane Systems
"As advances in nanofiltration (NF) continue to stream into the global marketplace, Koch Membrane Systems continues to maintain its established role as the prime innovator."

Woburn:
Aegis Semiconductor
"... wavelength-monitoring components and modules that are easily manufactured using proven methods from the semiconductor industry."

Angstrom Medica
"... a life-sciences biomaterials company that harnesses nanotechnology for orthopedic applications."

Nantero
"... developing NRAM, a high-density nonvolatile random access memory chip, using nanotechnology. The company's objective is to deliver a product that will replace all existing forms of memory, such as DRAM, SRAM and flash memory, with NRAM serving as universal memory."

BioTrove
"A privately held biotechnology company focused on leveraging revolutionary micro- and nano-scale engineering solutions that improve the efficiency and productivity of drug discovery."

Michigan

Ann Arbor:
Discera
Using technology developed by Dr. Clark T.-C. Nguyen, the University of Michigan and the University of California at Berkeley, Discera replaces the passive (and some active) components on a wireless circuit board with a single micromechanical system that offers exceptional reception quality. A member of the Ardesta family of companies.

Mayaterials Inc.
Organic/Inorganic Nanocomposites, Nanocomposite Coatings, Nanoporous Materials, Photonic Materials, Core-Shell Nanocomposites

NanoBio Corporation
"... a biopharmaceutical company whose mission is to develop and commercialize its high-value Rx and OTC pharmaceutical products enabled by its patented NanoStat™ antimicrobial nanoemulsion technology."

Nanocerox
(formerly TAL Materials) "... a nanotechnology company providing mixed-metal oxide nanopowder-based research and development solutions to corporate customers for photonics, energy conversion, catalysis, and structural ceramics."

T/J Technologies
"... designs, develops and manufactures advanced materials and devices for electrochemical energy storage and conversion."

Farmington Hills:
Advanced Sensor Technologies
"... developing and bringing to market a variety of miniature, sensor-based biotechnology devices for research and medical applications."

Kalamazoo:
NanoMed Pharmaceuticals
"... developing nanoparticle-based advanced drug delivery systems to diagnose and treat disease."

Lansing:
EcoSynthetix
"... is a clean technology company, positioned to replace petroleum-based industrial products with nanobiomaterials."

Laurium:
Keweenaw Nanoscience Center
(KNC) "Our mission is to develop low cost, abundant, clean, alternative energy, using nanotechnology, to produce highly efficient solar cells, fuel cells and fusion energy technologies."

Midland:
Dendritech
"... licensed by The Dow Chemical Company to manufacture and sell ethylenediamine-core poly (amidoamine) (PAMAM) dendrimers and other specialty dendrimers."

Mount Pleasant:
Dendritic Nanotechnologies Limited
A joint venture of chemist Donald Tomalia and Melbourne, Australia-based Starpharma Pooled Development Ltd.

Minnesota

Elk River:

Cymbet Corporation

(Cymbet) "... will be the first to market with a true solid state rechargeable battery (licensed technology) using a proprietary, patent pending manufacturing process. This Cymbet technology will enable new concepts in battery applications for IC's and new applications for handheld computer, communication, medical, sensor, and portable electronic devices. ... Oak Ridge National Labs brought the materials science, Cymbet brings the process science."

St. Paul:

Nanocopoeia

"... a drug formulation company bringing a proprietary ElectroNanoSpray™ technology for producing nanoparticles to the pharmaceutical and medical device industries."

Winona:

RTP Company

"Specialty thermoplastic compounds from RTP Company provide conductive, structural, wear resistant, flame retardant, soft-touch, and color properties in over 60 engineering resins."

Woodbury:

Cima NanoTech

"... an advanced materials company specializing in the production of nanoscale conductive dispersions for the electronics industry."

Missouri

Rolla:

Brewer Science - Specialty Materials Division

"Provides novel polymers and resins for use in MEMS device applications, Image Sensors and Flat Panel Displays."

St. Louis:

AP Materials

"Nanopowders and Nanotechnology for Advanced Materials."

Kereos

"... develops targeted therapeutics and molecular imaging agents that detect and attack cancer and cardiovascular disease earlier and more specifically than previously possible."

Nevada

Carson City:

US Global Nanospace

A Nano Science company developing innovative solutions for Homeland Security and Force Protections.

Henderson:

Emergency Filtration Products

"... formed to develop a preeminent filtration technology that would serve to ensure the safety of rescuers by virtually eliminating risk of cross-contamination during CPR."

Reno:

Altair Nanomaterials

A wholly-owned subsidiary of Altair Nanotechnologies Inc. Altair owns a proprietary technology for making nanocrystalline materials of unique quality, economically and in large quantities. The company produces closely-sized nanoparticles of titanium dioxide and related ceramic oxide materials and compounds.

New Hampshire

Keene:

Moore Nanotechnology Systems

"... dedicated to the development of ultra-precision machine systems, typically utilizing Single Point Diamond Turning and Deterministic Micro-Grinding technologies, for the production of plano, spherical, aspheric, conformal, and freeform optics."

Salem:

NanoTwin Technologies

"... focused on improving the quality inside your everyday, personal environment." Makers of NanoBreeze air purifier.

New Jersey

Dayton:

Salvona

"... develop and manufacture nanotechnology engineered controlled delivery systems and biodegradable devices for various commercial applications."

Ewing:

Nanergy

"We have a focused R&D on our patented, demonstrated proprietary method to store hydrogen in carbon nanotubes and several collateral applications. We believe this will lead to products for us in two to three years."

Universal Display Corporation

"... a leading organic light emitting device (OLED) technology developer with a broad intellectual property portfolio, years of experience in OLED research and development, and entrepreneurial management expertise."

Hillsborough:

Inmat

"InMat's proprietary nanocomposite technology provides customers with gas, vapor, and chemical barrier coatings that are thinner, lower cost, and more environmentally friendly than alternative barrier materials."

Iselin:

Engelhard

"Fundamentally, we manipulate basic materials - typically minerals - to alter their structure and surface characteristics. We manipulate them mechanically and chemically, altering their size, shape,

porosity and chemical characteristics to produce a wide range of functionality with important business uses."

Monmouth Junction:

PChem Associates

"... developed a patented nanomaterial technology for printed electronics."

Murray Hill:

Bell Labs

Lucent Technologies

Bell Labs Innovations

Newark:

Nanomedica

"... mission is to become a global leader in the development of dual-action therapeutics for the treatment of cancer."

Piscataway:

Diamond Materials

"Functionally Graded Nanophase Beryllium/Carbon Composites."

Nanopowder Enterprises

(NEI) Incorporated in 1997, NEI invents and develops proprietary, patented technologies for producing nanopowders and nanostructured intermediates.

Robbinsville:

Pars Environmental

NanoFe^{TM} remediation technology for soils and groundwater.

Somerset:

NanoOpto

"... applying proprietary nano-optics and nano-manufacturing technology to design and make components for optical networking. Based on years of research, the company's technology allows orders of magnitude more rapid prototyping, higher performance and lower overall system cost. Both on its own and with corporate partners, NanoOpto will use subwavelength techniques to produce better conventional optical components and also to create new classes of integrated components."

South Plainfield:

A&A Company

"Thermal spray coatings and nano thermal spray coating using custom designed metal, ceramic, cermet and hard faced materials."

New Mexico

Albuquerque:

MEMX

"The MEMX technical team spent ten years at Sandia National Laboratories developing and

perfecting the revolutionary SUMMiT V MEMS technology. We are now bringing the technology out of the labs and into the Commercial Sector." They work extensively with self-assembled monolayers and other nano-films and coatings to improve performance and reliability of their products. Also located in Sunnyvale California.

Nanopore
"... founded in 1993 with the purpose of commercializing high porosity/high surface area materials for a wide range of applications including adsorbtion, gas separation, advanced thermal insulation, low-K dielectrics, and optics."

Los Alamos:
Nanostructured & Amorphous Materials, Inc.
"... a provider of various nanostructured and amophous materials with a high quality, a large quantity, and a low cost."

Santa Fe:
Knowmtech
"... an intellectual property development and holding company that is currently developing a patent portfolio centered around nanotechnology-based neural networks, including neural network semiconductor chips and related devices and fabrication processes."

New York

Briarcliff Manor:
Nanocrystal Imaging Corporation (NIC)
"... founded in October 1997 to exploit some of NCT's discoveries in the creation of high quality digital x-ray images. ... Our practice of nanotechnology is based upon phenomena which produce non-linear attributes and properties of single atoms when confined within nanocrystals of sizes between 2 - 5 nanometers."

Buffalo:
NanoDynamics
"... founded in 2002 to develop and manufacture high performance nanomaterials for a wide array of customers and for integration into proprietary components and systems. The Company is pursuing commercial manufacture of nanocrystalline metals, ceramics, and carbon materials for a wide range of applications in energy, portable power, biomedical, transportation, electronics, defense, and many other industries."

Halfmoon:
DayStar Technologies
"DayStar strives to build a world of "Pervasive Solar Energy" to power every corner of the planet with photovoltaic products that remove materials and manufacturing barriers currently limiting widespread use."

Henrietta:
Integrated Nano-Technologies
"... developing ground-breaking products around a revolutionary approach for physically coupling molecular biology and microelectronics."

Ithaca:

Advion BioSciences

"... bioanalytical services and nanoelectrospray products."

Meliorum Technologies

"... fabrication of high-quality nanomaterials for university and industrial research, and application development."

Primet Precision Materials

An advanced materials company with expertise in controlling materials at the micro and nano scales to create new and useful macro effects.

Malta:

Starfire Systems

"... offers a wide range of patented silicon carbide (SiC) ceramic forming polymers and material systems that companies use to meet performance and cost targets where high temperature, corrosion resistance, wear resistance, and weight are requirements that must be met."

Milton:

Sono-Tek

"... applications such as the gentle drying of nano-particles, the isolation of highly effective pharmaceutical agents, the production of spherical ceramic matrices, or micro-encapsulation, as well as efficient and safe spray drying of aqueous and organic solvent-based solutions and slurries."

New York:

Advance Nanotech

"Operating in three areas, electronics, biopharma and materials, Advance leverages relationships with financial and development resources to enable a product focused, fast-track commercialization of nanotechnology."

Applied NanoMaterials

"... commercializes nanospheres and nanotubes of inorganic compounds discovered at the Weizmann Institute of Science in Rehovot, Israel. These materials are used in microelectronic, semiconductor, aerospace, lubricant and metal working markets." See funding article for more information.

Nanoscience Technologies

"... manages one of the few research efforts providing a viable mass manufacturing methodology and vehicle to deliver this technology (functional molecules) to the marketplace for commercial use."

Owlstone Nanotech

"Using leading-edge nanofabrication techniques, Owlstone has created a complete chemical detection system on a chip. A hundred times smaller - and a thousand times cheaper - than other currently available devices, the Owlstone detector overcomes many of the limitations of traditional detection technologies." (With a UK office in Cambridge)

Rochester:

- NaturalNano

a subsidiary of Technology Innovations, LLC "... processing and applications of naturally occurring nanoscale materials, such as halloysite, or manufacturable at very low cost and in high quantity."

Troy:

- Evident Technologies, Inc.

"... is a nanotechnology manufacturing and application company that draws upon semiconductor nanocrystal expertise to develop sophisticated, cost effective, innovative devices and products."

Watervliet:

- Applied NanoWorks

"... delivers next generation nanotechnology solutions today that work to meet your research, product development and technology innovation requirements. Our nanocrystal technologies deliver a wide range of nanocompounds ranging in size, form factor and properties to deliver tomorrow's solutions to your projects today."

West Henrietta:

- Biophan Technologies

"Biophan is developing technology to make biomedical devices safe, both implanted devices and those used in surgical and diagnostic procedures, and to reduce interference that these devices cause to Magnetic Resonance Imaging (MRI) image quality."

Yaphank:

- Nanoprobes

"... was founded to develop the most sensitive reagents and technology for detecting biological molecules."

Yorktown Heights:

- IBM Research

Nanoscale science department

North Carolina

Cary:

- Coventor

(Formerly Microcosm Technologies, Inc.,) ".... a product development company that continually transforms forward-thinking ideas into innovative communications and biotechnology products made possible by MEMS".

- Optotrack

"... research and development of novel optical, imaging, chemical, as well as biological sensors and microsystems. Optotrack is dedicated to commercializing its proprietary intellectual properties based on microfabrication and nanotechnology to seize rapidly growing market opportunities in the healthcare, communication, and homeland security industry."

Chapel Hill:

- 3rdTech

Maker of the NanoManipulator

Asklepios BioPharmaceutical
"... a biotechnology company engaged in the development and delivery of novel protein and cellular based therapies through design of proprietary Biological Nano Particles ("BNP")."

Liquidia Technologies
"... enables and develops an entirely new class of applications in microfluidics, soft lithography and nanoparticle fabrication, based on a novel fluoropolymer materials platform."

Xintek
Formerly Applied Nanotechnologies, Inc. (ANI) "... established in October 2000 to develop and commercialize applications of carbon nanotubes in various industries such as telecommunications, electronics and medical imaging systems. The Company also fabricates carbon nanotubes for use in the above-mentioned industries and the research community."

Gastonia:
AccuFLEX Golf Company
NanoShaft

Greensboro:
Filtration Technology Filtration, Cleanrooms, and Contamination Control

Nano-Tex
"... a research company founded on the principles of nanotechnology creating new or improved textile properties through molecular engineering. ... The principles of nanotechnology are utilized to create exceptional performance in everyday items: apparel, home furnishings, commercial interiors, industrial fabrics"

QuarTek Corporation
Active research programs in smart materials, nano-sensors for diagnostics, nano-tagging, and remote sensing.

Hampstead:
ec systems
"... assists companies in identifying products where carbon nanotechnology offers a clear path to improved performance. We perform complete feasability assessments, work with your team to formulate a development proposal and aid in the execution of the plan from pilot production through scale-up to commercial production." Also supplies nanotubes and related graphitic nanostructures.

Pittsboro:
Nanolume "... founded in 1998 for the purpose of creating devices from synthetically produced nanocrystalline semiconductors. It is an outgrowth of research done by the principals while at Duke University."

Research Triangle Park:
Alnis BioSciences
"... a drug development company with a potent, enabling therapeutic platform to treat cancer as well as infectious and inflammatory diseases. Alnis has engineered nanoscopic hydrogels, or NanoGels,

comprised of polymers, bioactives, and targeting molecules."

Nextreme Thermal Solutions
"Nextreme's devices employ nanoengineered layered semiconductors called superlattices that are created by stacking thousands of layers of thermoelectric material, with the layers between 1 and 5 nanometers thick."

Research Triangle Institute (RTI)
"In 2001, RTI initiated a new focus on nanotechnology to consolidate and coordinate years of successful work in thermoelectrics, materials science and engineering, and filtration and aerosol technology."

Winston-Salem:
NanoTechLabs
Various nanotubes, nanoparticles, and nanowires.

Ohio

Akron:
Ecology Coatings
"... focus on the development of nano-engineered, liquid 100% solids, ultra-violet curable industrial coatings."

Cedarville:
Nanographite Materials
(NGM) "... a joint venture between Applied Sciences, Inc., (ASI) and GSI Creos Corporation, (GSI). ... production and marketing of PyrografŽ-I vapor grown carbon fiber, and composite materials based on this fiber." Also located with GSI in Japan.

Cleveland:
Copernicus Therapeutics
"... a privately-held company developing products for human gene therapy and vaccination."

Five Star Technologies
"... an advanced materials company specializing in the design and manufacture of engineered materials and dispersions."

Quantum Polymer Composites
Thermoplastic Rubbers (TPR) and Rejuvenates of Rubber Scraps.

Columbus:
MetaMateria Partners
"... develops and manufactures nanopowders and components for fuel cells, batteries, membranes, other electrochemical devices, filters, rocket nozzles, and catalyst supports."

Dayton:
Applied Sciences, Inc.
(ASI) "... a nationally recognized Research and Development company specializing in advanced materials and their applications. ASI is located near Dayton, Ohio, and consists of three additional

affiliate companies, PyrografŽ Products, Inc. (PPI), Nano Graphite Materials (NGM), and Aqua Locator."

Kettering:

- National Composite Center (NCC)

"... promoting, developing and applying advanced composite technology to the aerospace and defense, automotive, commercial and infrastructure markets."

Valley View:

- Nanofilm

"... founded to develop and commercialize ultra-thin films, called nanofilms, to enhance the durability, clarity, ease of use and performance of transparent materials."

Westerville:

- BioCrystal

"... semiconductor-based, nanocrystalline fluorescent markers for cell and intracellular detection and analysis; therapeutic compounds and procedures for the diagnosis and treatment of cancer; and the very innovative OptiCell Ž, a product that represents a significant step forward in the evolution of cell and tissue culture technology."

Worthington:

- NexTech Materials

"... is developing a range of advanced ceramic products for the energy, automotive, medical, defense, and aerospace industries. Its core competencies are inorganic materials development, ceramic product development, synthesis and dispersion of nanoscale oxides, and scale-up of advanced powder synthesis technologies. Some of the products under development are described below."

Oklahoma

Broken Arrow:

- E47 Technologies

Advanced textile technologies.

Edmond:

- NanoBioMagnetics

"... engaged in the development and commercialization of magnetically responsive nanoparticle technologies for a range of human health applications for an emerging area of nanobiomedicine referred to as Organ-Assisting-Devices (OAD’s)"

- XetaComp

Specialty Nanopowders

Oklahoma City:

- Southwest Nanotechnologies

Produces Single-Walled Carbon Nanotubes (SWNT's) by Catalytic Disproportionation. See Controlled production of SWNTs at the University of Oklahoma

Oregon

Portland:

- AcryMed

"... a development and manufacturing company focused on the introduction of novel medical products that help heal wounds or reduce infections."

White City:

- NIC Industries

Powder, ceramic, and elastomeric coatings

Pennsylvania

Allentown:

- Agere Systems

(Formerly the Microelectronics division of Lucent Technologies) The "world leader in sales of communications components. We design, develop and manufacture optoelectronic components for communications networks, and integrated circuits for use in a broad range of communications and computer equipment."

- Air Products and Chemicals

"... atmospheric gases, process and specialty gases, performance materials and chemical intermediates."

Bridgeville:

- Climax Molybdenum

A subsidiary of Phelps Dodge Corporation. Engineered Materials.

Collegeville:

- Advanced Fibers & Powders

Technology development and advanced material manufacturing.

Lancaster:

- Illuminex Corporation

"... dedicated to engineering advanced nanowire device technology."

Leetsdale:

- Almatis

Specialty Alumina Materials

Malvern:

- Nanomaterials Company

Producer of complex nanopowders and nanostructured materials.

North Huntingdon:

- Allomet Corporation

Powered Metals

- Nanomat, Inc.

"... developed efficient and cost-effective processes to manufacture nanomaterials to meet a wide range of custom needs and specifications."

Philadelphia:

- Rohm and Haas

"... specialty materials with revolutionary developments in everything from electronic materials and polymers for paints to personal care products ..."

- Versilant Nanotechnologies

"... pioneers the invention, development and production of nanotechnology-based materials."

Pittsburgh:

- Crystalplex Corporation

"... develops tools to decode the complexity of today's problems in drug discovery and clinical diagnosis. With proprietary reagent technology based on nanocrystal-encoded microbeads, Crystalplex provides the means to interpret vast amounts of information."

- Pennsylvania NanoMaterials Commercialization Center

"A primary objective of this new center will focus on establishing Pennsylvania as the first-to-market leader in products and technologies that involve nanomaterials."

Sharon:

- NanoLogix

"... a biotechnology / genomics company owning 31 issued patents with applications in nanotechnology, hydrogen gas production, medical drugs/devices, bio-defense sensors and bioremediation."

State College:

- Keystone Nano

"... seeks to improve human health by creating new ways to diagnose and treat human diseases and improve the quality of life. Keystone Nano partners with healthcare companies to complete the development and speed the market launch of nano-enabled therapeutics to seek/treat/image a variety of conditions."

- NanoHorizons

"A Nanoscale materials and devices company providing solutions for: Drug discovery, Flexible Microelectronics, and Medical Diagnostics & Monitoring."

York:

- Industrial Science and Technology Network

"ISTN is a materials research company specializing in the development and commercialization of nanotechnology products for industrial applications. ISTN business plan focuses on three broad areas where it believes its core scientific competencies will be able to have a significant commercial impact - traditional industrial products, optical electronics and biotechnology."

Rhode Island

Providence:

eMembrane

"The Company's proprietary platform technology is nano-grafting of combinatorial polymer brushes."

Reade Advanced Materials

"... a manufacturer, value add custom processor, & global distributor of metal, alloy, ceramic, composite, usp, & fcc grade nano materials (nano particles, nano crystals, nano tubes, fullerenes, nano wires, nano fibers, quantum dots, doped nano particles, and encapsulated nano particles)."

Solaris Nanosciences Corporation

"... focused on developing nanoscale materials for large applications including the solar energy, display and vision markets."

South Carolina

Hilton Head island:

Molecular Electronics Corp.

"MEC is presently forming strategic alliances with industry partners for commercialization of the intellectual property, and for manufacturing and marketing of specific products based upon MEC's intellectual property."

Tennessee

Chattanooga:

eSpin Technologies, Inc.

"... polymeric nanofiber manufacturing technology applicable across the universe of emergent and traditional manufacturing sectors."

Steward Environmental Solutions

"Solving Environmental & Industrial Challenges in Liquids and Gases with Nano-Materials."

Kingsport:

Eastman

"... the largest producer of polyester plastics for packaging and is a leading supplier of raw materials for paints and coatings, inks, and graphic arts, adhesives, textile sizes and other formulated products, and of cellulose acetate fibers."

Voridian

A division of Eastman Chemical Company. "The world's largest manufacturer of polyethylene terephthalate (PET) for packaging and a global leader in the manufacturing of acetate tow."

Texas

Addison:

Authentix

"Formed by the merger of Isotag, Biocode and Calyx in 2003, Authentix combines 20 years experience in providing comprehensive services and technology for the prevention of product counterfeiting, brand adulteration and product diversion." (Corporate Headquarters)

Austin:

Applied Nanotech

A subsidiary of Nano-Proprietary, Inc. "Currently ANI is in advanced development for the application of electron emitting carbon nanotubes cathodes in a number of areas, including large area color televisions, new lighting devices, x-ray, and microwave generators."

HelioVolt

"... has developed the fastest and most effective way to manufacture CIS (Copper Indium Selenide), the most reliable and best-performing thin film material for generating electricity from sunlight."

InnovaLight

"developing solid-state lighting solutions based on its luminescent silicon nanocrystals."

Introgen Therapeutics

"... a biopharmaceutical company focused on the discovery, development and commercialization of molecular therapies for the treatment of cancer and other serious diseases."

Nanoclay

"CloisiteŽ additives consist of organically modified nanometer scale, layered magnesium aluminum silicate platelets. The silicate platelets that CloisiteŽ additives are derived from are 1 nanometer thick and 70 - 150 nanometers across."

nanoCoolers

"... advanced cooling technology, nanoCoolers offers thermal management solutions that will revolutionize the computing, communication and refrigeration markets among others."

Nanotechnologies Inc.

"... provide unique materials for a wide variety of industries and performance-driven applications."

Quantum Logic Devices

"... focus is on single-electron transistor platforms, based on quantum dots, that use very low power."

Xidex

"... an Austin-based nanotechnology company in the business of developing carbon nanotube based mechanical, electrical and logic devices together with micro- and macro-scale products that incorporate these nanodevices."

Dallas:

Carbon Designs, Inc. (CDI)

"... producing CNTs, CNT-based carbon fibers, and CNT Composites with superior mechanical properties."

Raytheon's Nanoelectronics Branch

Develops future-generation analog and digital technologies for commercial and defense applications in radar, communications, and sensor processing.

Cytoplex BioSciences

"Cytoplex offers nanotechnology solutions that provide high levels of information content about cell-drug interactions. Cytoplex's technology simplifies "ion channel" screening, which is key to researching central nervous system, cardiovascular, and other diseases."

Texas Instruments

Houston:

BuckyUSA

Specialty manufacturer of carbon nanomaterials.

Carbon Nanotechnologies, Inc.

"The Leader in Carbon Nanotechnology and Single-wall Carbon Nanotube Production."

NanoComputer Dream Team

Multidisciplinary project to make first nanometer supercomputer via the Internet.

Nanospectra LLC and Nanospectra Biosciences, Inc

"... founded in January 2001 to commercialize technology developed at Rice University by Dr. Naomi Halas and Dr. Jennifer West. The company's IP portfolio includes a broad range of industrial, photonic and biomedical applications that are enabled by the ability to manufacture and tune nanoshells across a wide range of optical properties. Nanospectra Biosciences, Inc. was formed in August 2001 to develop the life sciences applications of this technology."

SES Research

"... one of the first commercial manufacturers of Carbon Fullerenes to supply research communities worldwide."

El Paso:

Nanoforce Technologies

"... aggressively pursue Nanotech research opportunities, primarily focused in the area of improving commercial products used in day-to-day activities."

Refinery Science

"... meeting the increasing demand for energy independence through nanotechnology"

Montgomery:

Liquid Minerals Group

"LMGI's smaller nano particles allow lower dosage rates and, therefore provide customers a lower treatment cost while increasing the passivation of contaminant metals found in heavy fuel oils. LMGI's combines established chemistry knowledge into the expanding art of nanotechnology that has allowed us to reach higher levels of concentration and performance."

Richardson:

Helix Material Solutions

"... a nanotechnology company based in Texas and founded by a group of world-class experts and scientists in nanoscience and nanotechnology, who are devoted in bringing the best nanoscale materials to the market at affordable prices."

Zyvex
Molecular Nanotechnology research company. Working in the areas of Nanomanipulation, Mechanochemistry, assembler system design, CAD, and others. Interview with James Von Ehr II by John C. Snider

San Antonio:
Advanced Nano Coatings
"... a producer of high performance, VOC compliant epoxy coatings."

Nanotechnology Development Corporation
(NTDC) Formed to rapidly exploit the advances being made in the field of Digital Matter Control.

Utah

nCoat
"... a nanotechnology research, commercialization, licensing and distribution company. Through its subsidiary companies, nCoat develops and distributes commercially viable proprietary nanotechnology and traditional coating products."

Draper:
Sequoia Pacific Research Company
"... a chemical research and development holding company, which applies the science and art of Nanochemical Technology to create new products and unique chemical process applications."

Salt Lake City:
Ceramatec
"... nano-powders for targeted applications like infrared windows, catalysts, fuel cells, and even cosmetics."

Vermont

Brattleboro:
Cheap Tubes
"... committed to supplying the nanotechnology research and industrial community with the highest quality carbon nanotubes (CNTs) at the lowest prices."

Windsor:
Seldon Laboratories
"... a privately held nanotechnology company focused on incorporating the unique properties of carbon nanotubes into products for today's markets."

Virginia

Blacksburg:
Luna Innovations
"... a research and development company specializing in developing and commercializing basic research into cost-effective products that are beneficial to society.

Luna nanoWorks

A division of Luna Innovations Incorporated. "Luna nanoWorks' new composition of matter is called Trimetasphere™ carbon nanomaterials (M3N@C80) -a fullerene sphere enclosing three metal atoms in a nitride molecule. The entrapped metals provide unique physical, chemical, thermal, magnetic, biological, optical and electronic properties that differentiate them from other carbon nanomaterials."

NanoSonic Inc.
"... have developed new molecular self-assembly processes that allow control of synthesized material structure at the nanometer level, as well as the manufacturing of new materials with designed constitutive behavior."

Fairfax:
Materials Modification Inc. (MMI)
"... aim of developing new materials and processes in the field of Materials Engineering."

Glen Allen:
NanoMarkets
"... analyzes the market opportunities and disruptions brought about by advances in technology at the micro and nano scale."

Lorton:
Nano Interface Technology, Inc. (NITI)
"We are a pioneering research organization committed to develop novel nanotechnologies in biotechnology, material sciences and the drug delivery areas."

McLean:
MITRE Corporation Nanoelectronics & Nanocomputing Home Page
Reviews current nanotechnology research and people behind it, downloadable copies of several widely-used articles. Nanoelectronics and Nanocomputing focus.

Richmond:

Abtech Scientific
"... a biomedical diagnostics company that delivers biosensor devices, biosensor instruments and biosensor systems to the biomedical research community and the point of concern biomedical diagnostics market."

Washington

NanoCraft
"... nearly pure Nanohorns and Nanotubes ... to serve both research and industry orders."

Bothell:
Lumera
"... develops proprietary polymer materials and products based on these materials for a broad range of applications. We engineer polymer materials at the molecular level - commonly referred to as nanotechnology - to optimize their electrical, optical and/or surface properties."

Bremerton:

LiftPort Carbon Inc.

A LiftPort Group Company "By bringing advanced carbon nanotube products to market now, LiftPort Carbon, Inc. (LPC) is working to develop the carbon nanotube technology which will enable creation of the space elevator in the future."

Seattle:

Asemblon

"... specializing in the emerging field of self-assembling molecules or SAMs."

Isotron

"...advanced coatings, polymers and materials for high-performance industrial, military and civil transportation applications."

Nanostring Technologies

"NanoString Technologies is developing a patent-pending nanotechnology-based platform for high speed, completely automated, robust, highly multiplexed, single molecule identification and digital quantification."

Washington, D.C.

Nanotec-USA

"... partnered with Nanotec Pty Ltd. We have introduced true nanotechnology water repellent and easier to clean/self cleaning permanent treatments to the United States."

Sughrue Mion

Nanotechnology Patent Practice Group

Wisconsin

Madison:

Platypus Technologies

"... develops, produces and markets nanotechnologies for the life sciences. We produce a variety of nano-structured surfaces for use in research and are also developing a range of products that derive from a proprietary platform technology for the rapid detection of molecular interactions."

West Virginia

Triadelphia:

CFOAM

"Developed by Touchstone Research Laboratory, Ltd., CFOAM is a cost-effective, next-generation carbon foam structural material."

Wyoming

Cheyenne:

Industrial NanoTech

"... funds & participates in reseach with the world's brightest scientists and leading laboratories." Makers of Nansulate™ nanocomposite insulation.

Laramie:

Nanomaterials Discovery Corporation
"... combines the power of combinatorial chemistry with the versatility of electrochemistry to discover and refine nanomaterials with high economic impact. NDC focuses on discovering and refining the nanostructured materials that can fundamentally change the world in which we live."

Sites with no stated location:

Bonderite NT
Nanoceramic Technology

Clean Technology International Corp.
"... is committed to producing Nanocarbon materials."

Fractal Robot Digital Matter Control

GEMZ Corp.
"GEMZ Corp. recently incorporated its wholly-owned subsidiary, International Nanotechnology Corp. The Company has as its goal to Develop patented, commercial products using Nanotechnology to harness renewable energy."

Molecubotics
"Molecubotics intends to develop a general method for assembling complex nanostructures, using components and methods from biotechnology."

Nano and Giga Solutions
"Our main focus is computational modeling and simulation for nanotechnology applications. We develop and apply different computational and experimental tools to solve complex multi-disciplinary problems in process, materials, and device design related to the development of advanced technologies."

Nanocs
"... a research and development company focusing on hydrocarbon polymers, nanophase carbon materials (carbon nanotubes, nanodiamond, nanocomposite) process and related fabrication systems."

Nanodisc
"... owns an exclusive, world-wide commercial license to all applications of Nanodiscs™ - nano scale, discoidal structures composed of specially engineered proteins and phospholipid bilayers."

Nanopharma
A privately-held spinoff from Massachusetts General Hospital, founded to develop advanced drug delivery systems, and to provide fully biodegradable nanoscopic drug delivery vehicles based on proprietary molecular constructs and "biological stealth" materials.

NanoSperse
"... founded in 2003 to enable the rapid commercialization of polymer nanotechnology by utilizing proprietary platform technology developed by the Air Force Research Laboratory and the University of Dayton Research Institute."

Telomolecular Corp.
"... develops nanotechnologies capable of delivering large-molecule proteins across human cell membranes."

Vantage Resin Systems
"... a Nanotube-Neutral formulator of carbon nanotubes for thermoset epoxy applications."

Xenolix
"... a development stage enterprise, is inventing, researching and developing new precious metals analytic and extraction technologies based upon the science of nanotechnology.