

NYC Resistor is a hacker collective with a shared space located in downtown Brooklyn.

We meet regularly to share knowledge,
hack on projects together, and build community.

conductive paint, wire glue and nickel print

:: conductive paint is infused with silver or copper particles. Tends to crack and is expensive due to the high content of silver.

:: wire glue is a lead free conductive adhesive made with micro-carbons. It's an affordable alternative to expensive silver-loaded epoxies and easy to apply (stir well and apply with a toothpick). It takes a few hours to cure and is intended for low currents (not sure how it performs in high power circuits). It's weak as a glue but good as a conductor.

:: nickel print is a conductive ink designed for PCB repair and RF shielding. Can be used as a conductive ink, but has slightly more resistance than silver based paint. Conducts better than the graphite based glues and is much cheaper than silver based paint.

:: suppliers: [thinkgeek](#), [MG chemicals](#)

UV reactive materials

:: aka solar active, materials impregnated with varying amounts of photochromic pigment that respond to the UV component of daylight by changing from a pale white to bright colors. When not exposed to UV rays photochromic materials revert back to their original color.

:: photochromic pigments (made of micron-size microcapsules of photochromic dye dispersed in water) when mixed with a binder, such as an acrylic base, can be permanently applied to any surface.

:: materials impregnated with photochromic pigments include paint/ink, fabric, sewing thread, glass, plastic, paper, leather, and more.

:: photochromic materials are compounds that undergo a reversible photochemical reaction where an absorption band in the visible part of the electromagnetic spectrum changes dramatically in strength or wavelength.

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UV reactive materials



UV reactive beads and thread (indoors and outdoors)

mylar

:: technically metalized PET film. Is cheap and widely available. The metalized layer is on one side only and is conductive.

:: can be used to make capacitive touch sensors. We are planning to experiment and use it for flexible circuit boards as well.

:: common ways to shape PET films include laser cutting, thermoforming, thermal bonding, glue and solvent bonding and simply cutting with scissors or razor knives.

thermochromic materials

:: thermochromic pigments change color when exposed to heat and turn back to their original color when the temperature drops again.

:: thermochromic pigments can be used to make color changing paint, fabric, tiles and film.

:: thermochromic materials can be activated through body heat, a hairdryer, a space heater, nichrome or just a hot summer day.

:: most thermochromic materials are based on liquid crystal technology. At specific temperatures the liquid crystals re-orientate to produce an apparent change of color. The liquid crystal material itself is micro-encapsulated - i.e., contained within microscopic spherical capsules typically just 10 microns in diameter.

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thermochromic materials



shi yuan :: heat-activated wallpaper

polymorph, sugru & mold making putty

:: polymorph, aka polycaprolactone, is a biodegradable polyester with a low melting point of around 60°C. It can be heated with just hot water and then molded by hand or cast into a mold (avoid using flames to melt polymorph as this will blacken the material. Once it cools to room temperature, polymorph becomes a hard, nylon-like plastic. It can be reheated and reshaped any number of times. Polymorph is usually white, but it can be colored with some colorings.

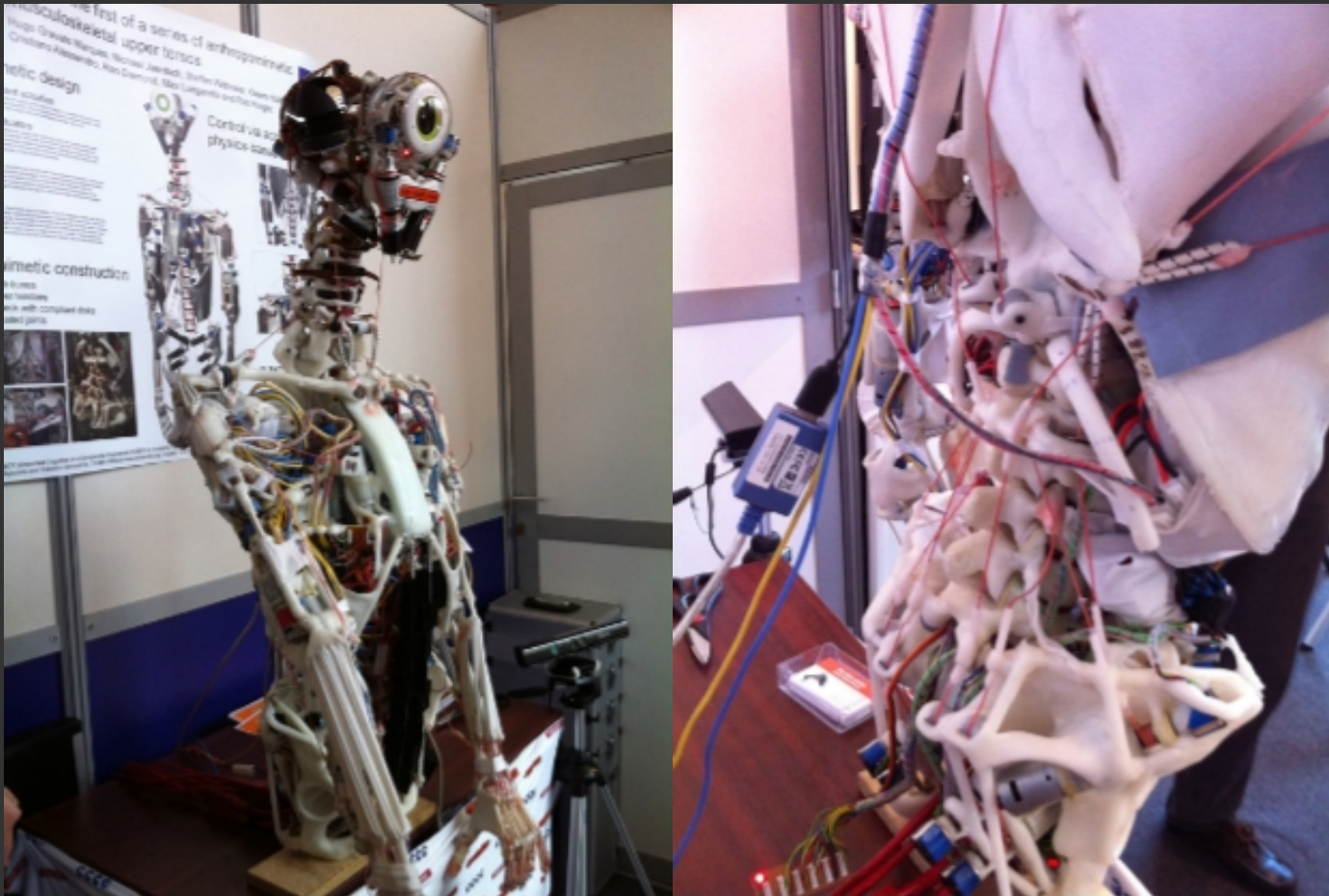
:: sugru is a multipurpose material developed specifically to “hack things better,” looks and feels like playdoh, comes in air-tight pouches and cures at room temperature, its self-adhesive, resistant from -60 °C to +180 °C, and waterproof.

:: mold making putty: cures in 10 minutes and its finished molds are permanent, flexible and replicate small details. Can withstand temperatures up to 650° F.

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:: suppliers: [sugru](#), [inventables](#)

polymorph



ECCEROBOT :: polymorph 'bones'

quantum tunneling composite (QTC)

:: smart flexible polymer, with extraordinary electrical properties, used for pressure switching and sensing.

:: in its normal state it's a near-perfect electrical insulator, but when deformed QTC becomes a metal-like conductor capable of passing very high currents. A QTC pill measuring 4mm square and 1.5mm thick can pass up to 10 amps when squeezed.

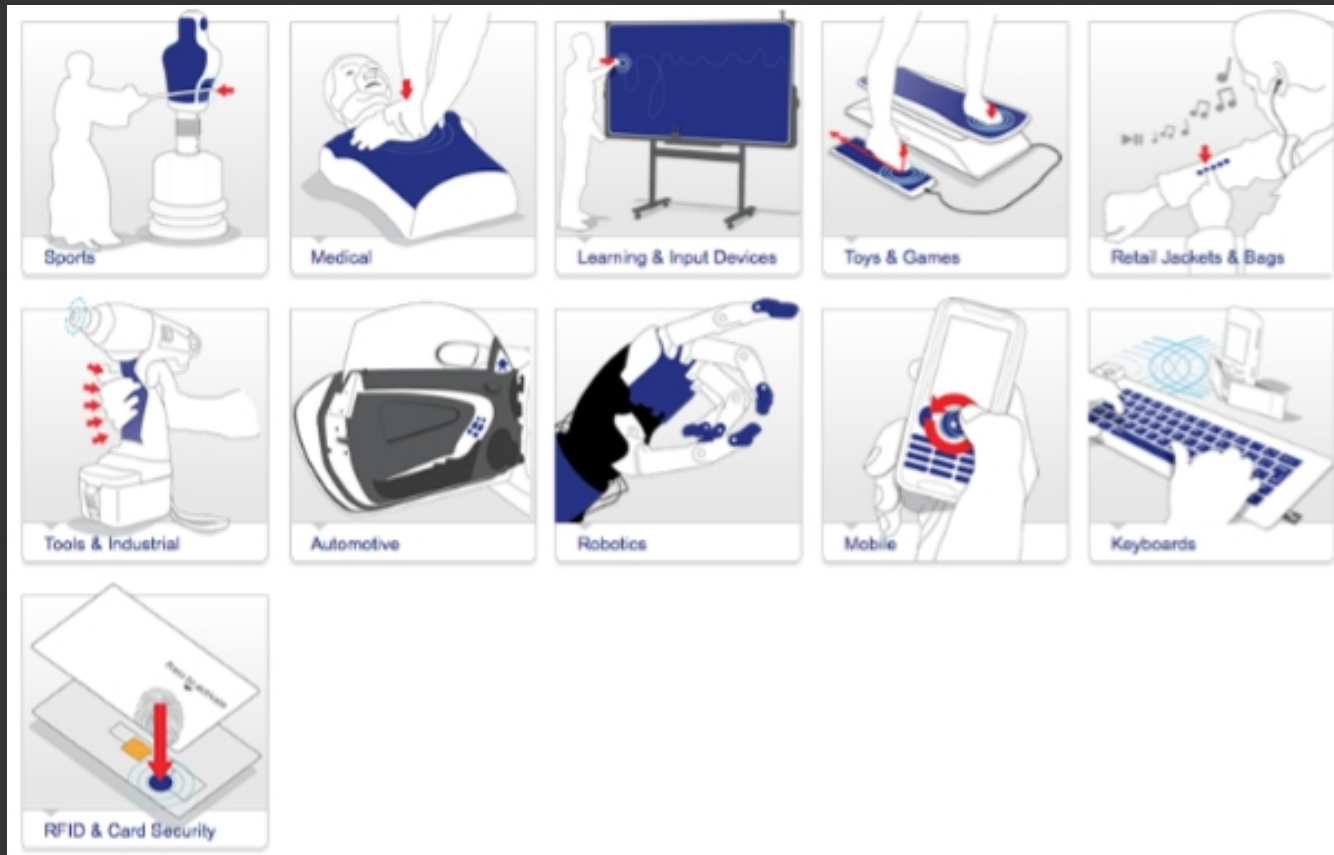
:: magnetic in both its insulator and conductive states.

:: ElekTex is a QTC-based electro-conductive fabric made up of two layers of conductive fabric with a thin layer of QTC in the middle.

:: QTC is made of metal filler particles combined with silicone rubber. QTC owes its extraordinary properties to a quantum tunneling phenomenon: electrons tunnel through the material, i.e. conduct, when their physical structure is slightly changed by pressure.

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quantum tunneling composite



peratech :: possible applications of quantum tunneling composite

QTC :: ElekTex



elektex keyboards

endlighten or edge diffusing acrylic

:: a type of acrylic that has microscopic particles suspended in the resin. Has a high light transmission. At first glance it appears no different than clear acrylic, but when illuminated from the edge it diffuses the light out the faces of the material.

:: normal acrylic faces show little change when edge light unless the surface is etched.

:: is available in sheets and solid tubes.

:: useful for multi-touch projects, LED back lighting and other visual effects.

:: *supplier: evonik*

shape memory polymers

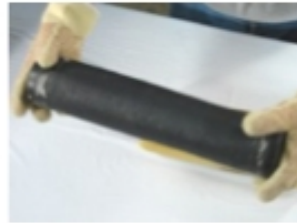
:: shape memory polymers (SMP) can be re-shaped when exposed to heat and will retain this new shape after cooling down. But once exposed again to the change-over temperature the polymer will revert back to its original shape. The physical properties, behavior and change-over temperature vary greatly from SMP to SMP.

:: SMP applications include smart mandrels which can be first shaped into the desired form and then easily removed by re-heating the material.

:: the secret behind SMPs lies in their molecular network structure, which contains at least two separate phases. The phase showing the highest thermal transition is the temperature that must be exceeded to establish the physical crosslinks responsible for the permanent shape. The switching segments, on the other hand, are the segments with the ability to soften past a certain transition temperature and are responsible for the temporary shape.

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hacking materials :: nick vermeer & catarina mota



Step 1: A shape memory polymer Smart Mandrels mandrel.



Step 2: The mandrel is placed into a clamshell mold, heated above its transition temperature, and blown into its complex shape under air pressure. While still under air pressure, the mandrel is cooled in its new, rigid complex shape.



Step 3: Once cooled, the mandrel is removed from the mold and installed on a filament winder.



Step 4: The rigid mandrel is filament-wound.



Step 5: After the filament-wound composite part cures, the mandrel is heated above its transition temperature. This allows it to return to its "memorized" tubular shape in an elastic state and be easily removed from the composite part.



Step 6: The composite part is completed. The Smart Mandrels tube can then be remolded and reused with no degradation in material properties.

smart mandrels

piezo film

:: piezoelectricity is a charge that accumulates in certain solid materials such as crystals, some ceramics and biological matter, in response to applied mechanical stress. The word piezoelectricity means electricity resulting from pressure.

:: when physically deformed, piezoelectric crystals generate an electric charge. The reverse is also true, if an electric charge is applied to the crystal, it will change shape slightly.

:: the piezoelectric effect creates high voltage, but because of the high internal resistance of the crystal it produces very little current.

:: a 7 cm strip of piezoelectric film can generate the 90V necessary to make a neon bulb flash.

conductive plastics

:: polymer bases infused with conductive additives.

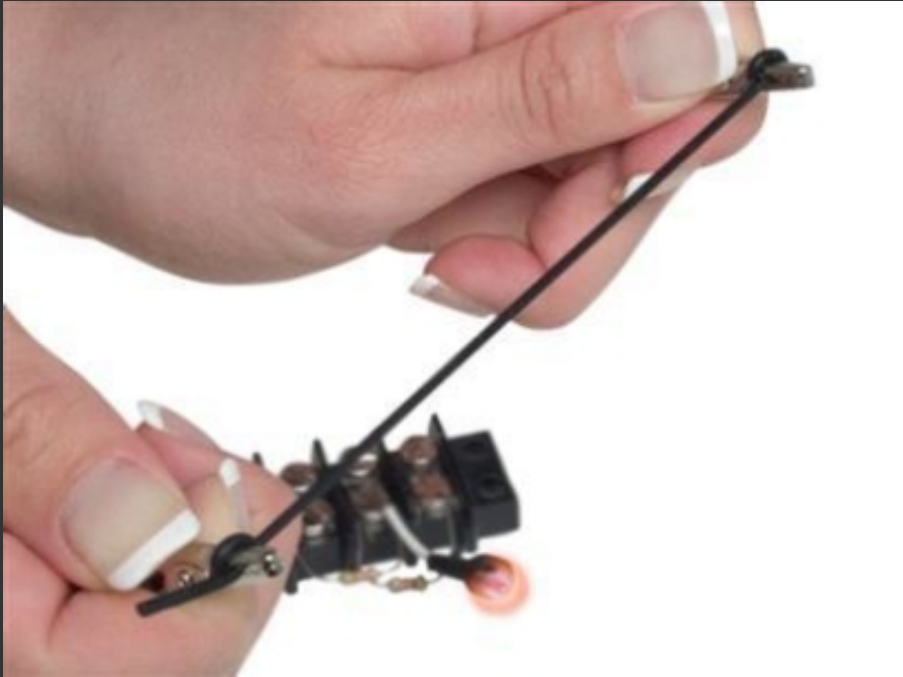
:: electrically conductive plastic board is infused with graphite making it conductive all over.

:: stretch sensing band is made out of a synthetic rubber base mixed with carbon black additives. When stretched the relative proximity between the conductive particles decreases thus increasing resistance.

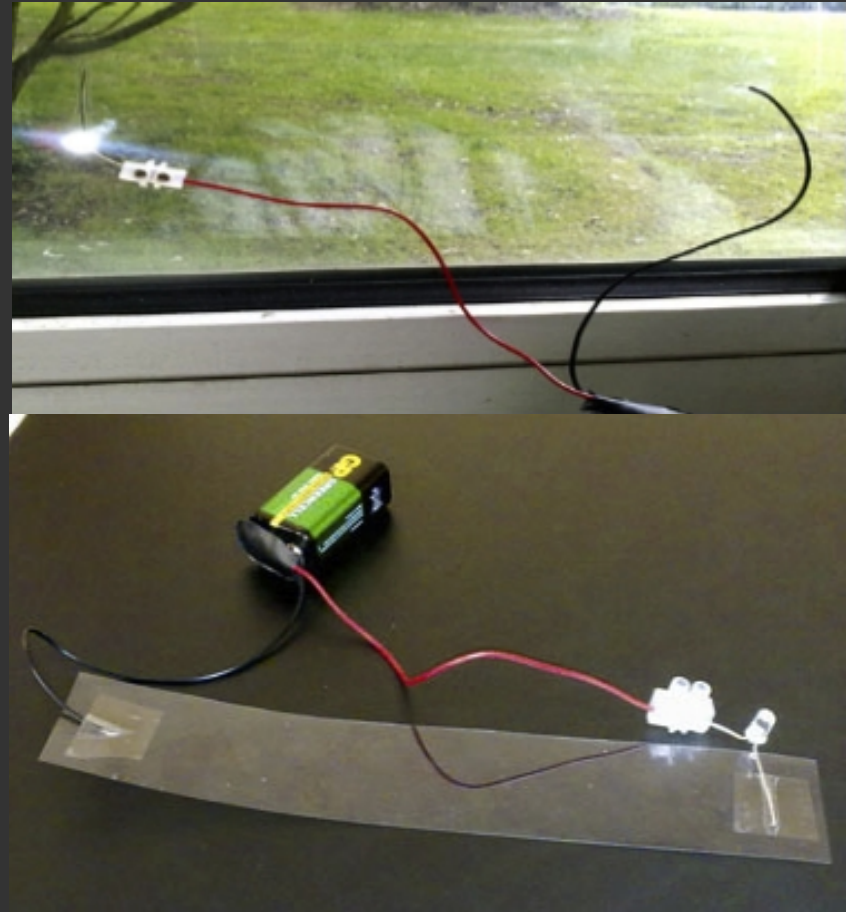
:: faraday film is a clear material, with the look and feel of acetate, coated on one side with a film of metal only a few atoms thick.

:: *suppliers: inventables, mindsets, lessEMF*

conductive plastics



stretch sensing rubber



faraday film

electrotextiles

:: fabrics with electrical properties made by blending or coating textiles with copper and/or nickel and/or silver fibers, available in many textures such as nylon, lycra, clearmesh, softmesh, zelt, thermoadhesive (iron-on), etc.

:: electrolycra, aka conductive stretch fabric, has special properties: in addition to being highly conductive, it warms up when current passes through a thin strip of the material, and its resistance increases or decreases when it's stretched

:: velostat is an anti-static film whose resistance decreases when pressed

:: these materials can be used to make a variety of sensors by layering them in appropriate combinations of conductivity and resistance

:: conductive thread is silver plated nylon thread, conductive yarn contains inox. Resistance increases with length of thread, on some yarns the resistance increases when the material is stretched. Resistive thread is good for embroidering resistors and making textile potentiometers.

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EL wire

:: electroluminescent (EL) wire glows when an alternating current is passed through it

:: consists of 4 or 5 concentric layers: a core copper conductive wire coated in phosphor, around which are wrapped two other very fine conductive wires, followed by a clear protective sleeve and/or a colored PVC sleeve. Current flowing through both the core and the two thin copper wires creates an electrical field and causes the phosphor to glow

:: requires an inverter to step up the current provided by batteries and should be handled with care as there is a risk of getting zapped

:: exists in a varied diameters (from 1.2mm to 5mm) and colors (produced by both the inverter frequency and the plastic sleeve)

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conductive sugar beads

:: sugar coated with sterling silver power

:: pretty good conductor

:: we're not sure what to use them for :)

acrylic and delrin

:: acrylic is a workhorse laser cutter material. Often called Plexiglas. Quite rigid, but cracks propagate at high speed. Generally not suitable for structural uses. Available in many colors, shapes, and optical characteristics and is very affordable.

:: delrin – also known as acetal. Strong and low friction material. More resilient than Acrylic and a good choice for mechanical components. Laser cut gears which good wear characteristics.

engineering plastics

:: Ultra High Molecular Weight Polythene. Commonly found in cutting boards. Incredibly impact resistant. Not rigid due to low yield strength. Low coefficient of friction. Useful for chain guides or bushings. Can be used as a surface to protect against abrasion. Can't laser cut, as it reacts as a wax, but can be machined and cut using various saws.

:: Polycarbonate: very strong plastic available in transparent varieties. Rigid and impact resistant. Also known under the Lexan brand name. Can be used as protective shields that do not obstruct vision. Scorches when heated, can not be flame polished. Can be laser cut, but it leaves yellow/brown edges. Can be machined or sawed

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