9/01/2023

Blood Brain barrier

Smart Materials

→ Materials which changes its ~~dimensions~~ due to some external stimulie chemical/physical properties called stimulie responsive material. (Smart materials)

BP → Na/K ions (external stimilie)

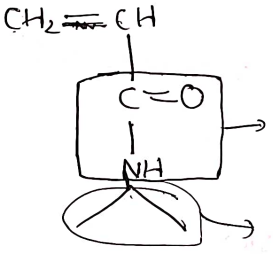
Nanarobot

Click-Grab Actuator

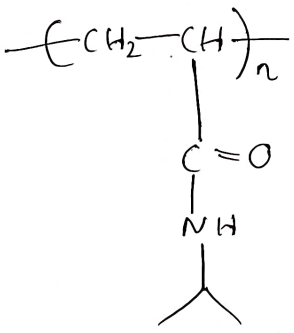
→ arm,

→ change its shape due to change in environment.

(pH → carcer cell diff from Normal cells.)



PNIPAM



linear.

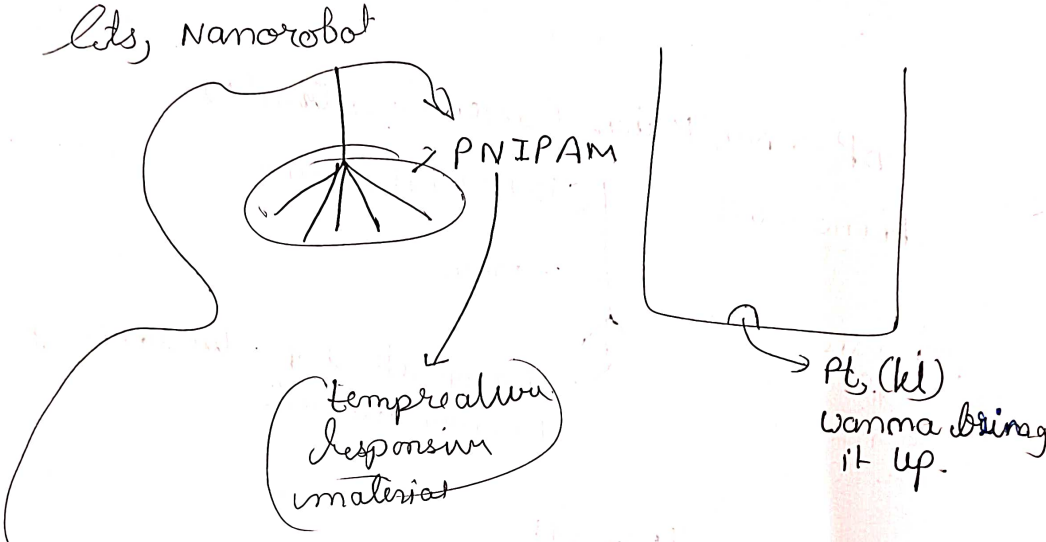
T > 32°

NOT, much Soluble. (precipitate) globul.

temp. at which it becomes precipitate → Lower critical solution tempreature (LCST)

↓

below LCST → soluble
above LCST → insoluble



Used to make activator which are temp. responsive.

→ Redox responsive

Cysteine ⇌ Cystine

–SH ⇌ S–S

dynamic exchange (auto matic)

Octopus

monofunctional.

tetra func.

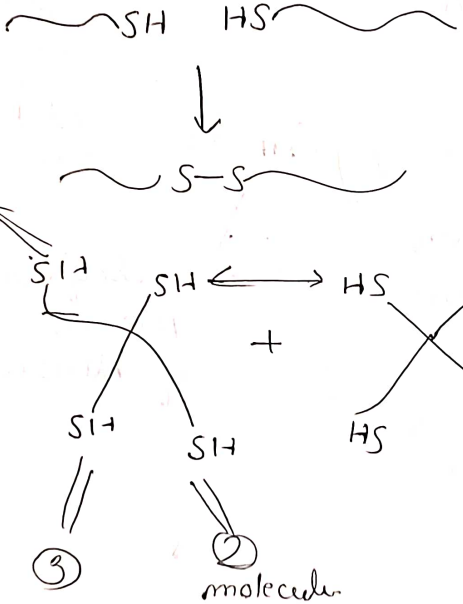
octa func.

} star materials

Mikto arm

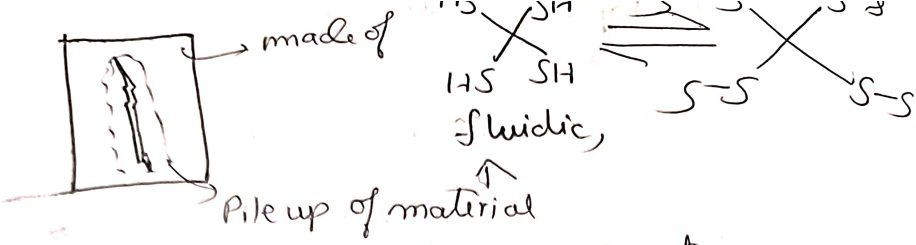
1 func. absent

Redox Responsive

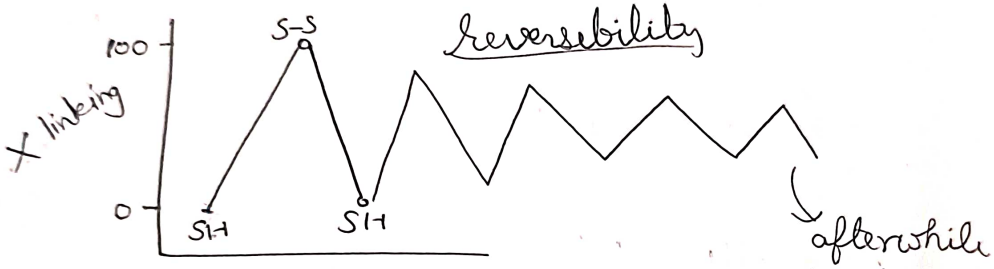


Can be used to make self healing material

1 tetra molecule can form struc. with 4 molecule makes it rigid / insoluble /



for then fill the crack and cross link to heal the scar.



→ Atomic force microscopy (AFM)

↓

70,000 X zoom,

scratches the surface,

to see Self healing process of Nano cut

March, 2020

Genome Sequencing.

Seq. of amino acid → protien.

Genom equencing
↓
wanna study the constituents
Separation of protein (similarly sited)

Problem,

A + B + C

monocationic
+ + +

zwitterionic
+ −

monoanionic
− − −

let $^{+}A + {}^{+-}B + {}^{-}C$ mixture,

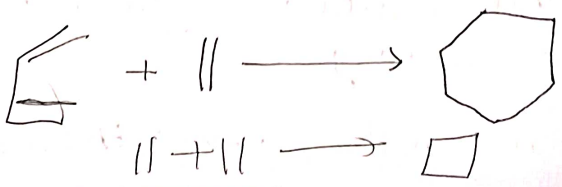
passed through, +ve membrians
-ve membranes

A^{+-} left only,

SH
OH
COOH
SO_3H
amine
CO_2H

SH
OH
COOH

pH responsive membranes are used to separat ^{+}A, $^{+}B^{-}$, ^{-}C

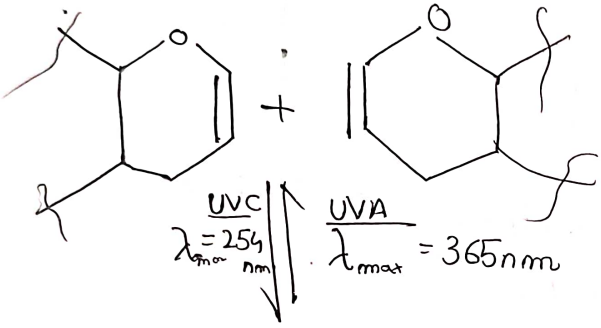


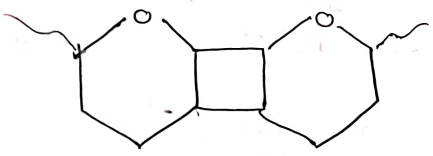
Light responsive material

chromophore → material that absorbs light

(Chlorophyll)

→ coumarin → chromophore.





dimerization (crosslinking

Using UVC, UVA, we can make crosslink, delink

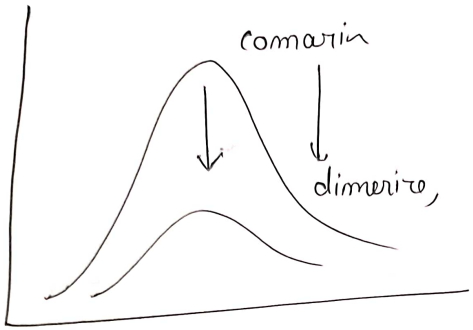
by the hole in ozone, UVA, UVC are available for free, 5-10%.

due to this, material is going through dynamic exchange

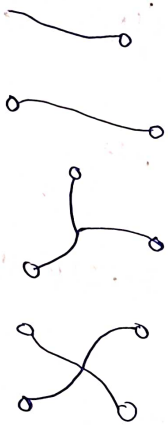
∴ SH–SH cause rotten egg smell, this material is used

can also be used as self healing

1.



→ functionalities



monofuctional

bifunctional

trifunctional

tetrafunctional

→ copolymer:

AAAAA

AAABBB - Diblock copolymer.

'A' Block 'B' Block.

ABC ⟶ triblock copolymer.

ABA ⟶

$H_2N-(Lys)_n-NH_2$

byfunc. polylysine

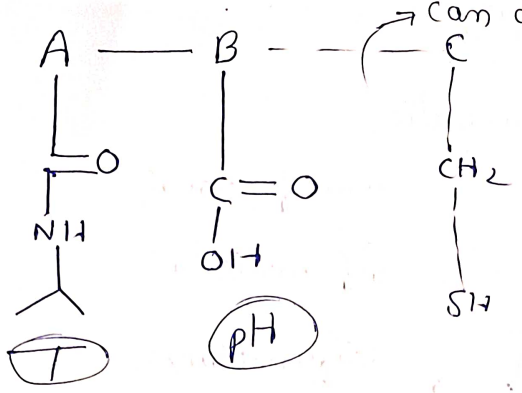
$\downarrow H_2S$

$(HS)_m-(Lys)_n-(SH)_m$

A B A

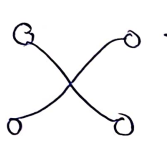
Bifunctional polylysine

let A-B is Bifunc. compolymer

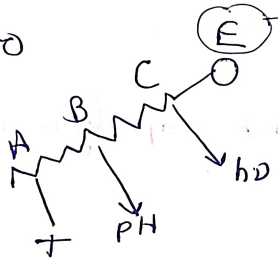


in a single material → multiple stimulie responsive

star material



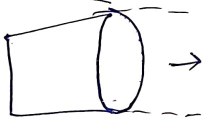
→ redox / hν responsive,



→ redox / hν / click / host guest comp. forms 3d structure.

11 + 11

Cyclodextine



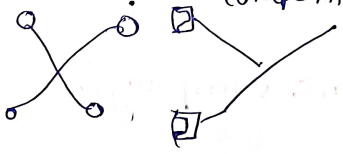
→ Nano-Bucket

called nano-container, have small spaces.

can we do chemical Rxn inside that?

10^{-9} molar dilution → can get single molecule separated, Rxn become faster.

host guest complemation.



form Complex when size matches

how does self healing material join?

- H-Bonding interaction,
  Non-isocyanate polyurethin
  with mult H-Bond site,

→ cant be separated by UTM also.

Biodegradable → degrade
Bioaccumulative → accumulate slowly
Biocompatible → fool the body by some protien coating.

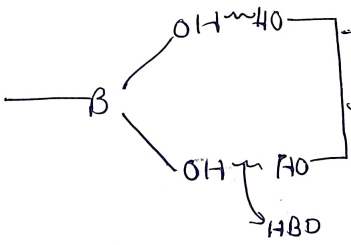
Polylysine ↑

→ Chemoresponsive.

Boronic acid.

How to detect diabetes cost effectively.

Fluroscent detection → by eyes, but costly



PDMAEMA

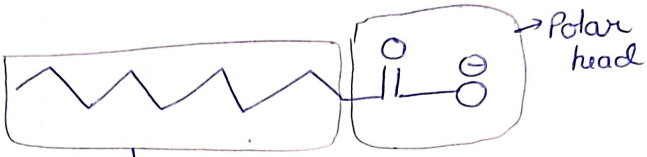
1

Thero +pH

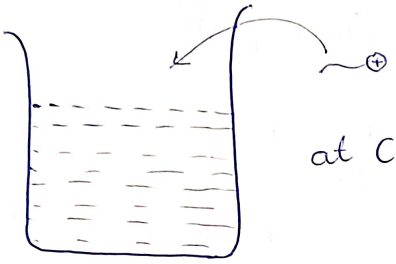
18/01/2023

✳ Double stimuli responsive ~~mater~~ polymer.

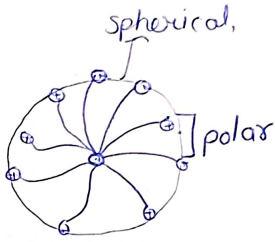
- Surfactant: ⇒ contain polar head groups and non-polar tail
  ↓
  (Shampoo)



tail (NON polar)



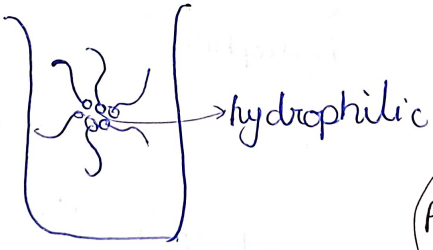
at CMC,



Micelle.

→ above CMC dirt is attracted and encapsulated inside the miscelle

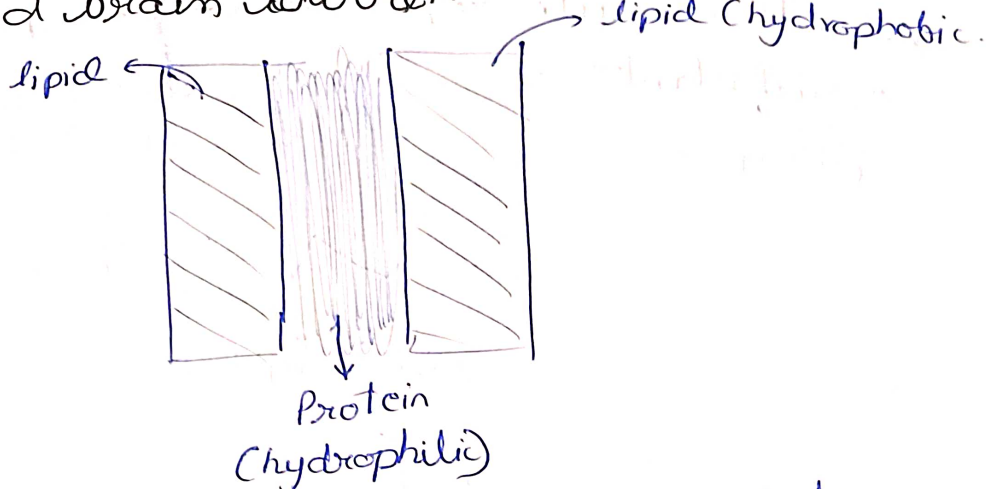
→ Reverce miscelle in organic solvant a hydrophillic core is formed,



in hexane

polyglycolic acid
Oxygen barrier
moisture barrier

→ Blood brain barrier



to penetrate inside, drug should be allrounder, therefore it should be both hydrophilic and hydrophobic

→ SURFACTANT:

- Block copolymer.

AAA BBB

hydrophobic ← AAA

BBB → hydrophilic. → PEG.

can be considered as surfactant.

also called, Amphiphilic block copolymer.

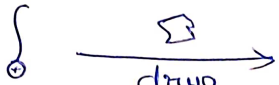
↓

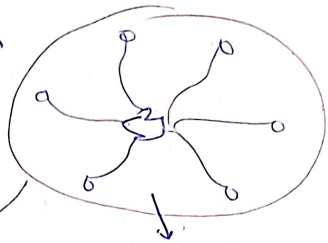
can be used to deliver drug.

CHROMOPHOR are used to check when micelle is forming or not

→ Cancer cell

pH lower than normal.





taken to desired place. to release

→ In case of cancer, a little dec. in pH, triggers to release the cargo (drug)

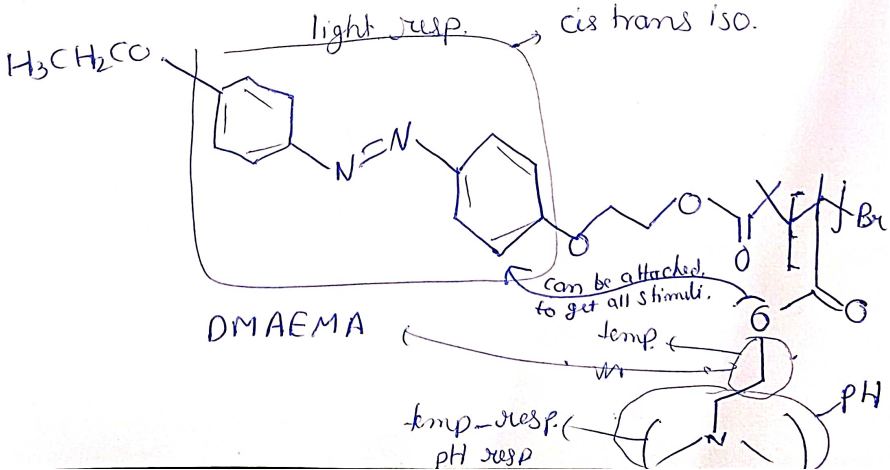
encapsulation

Release.

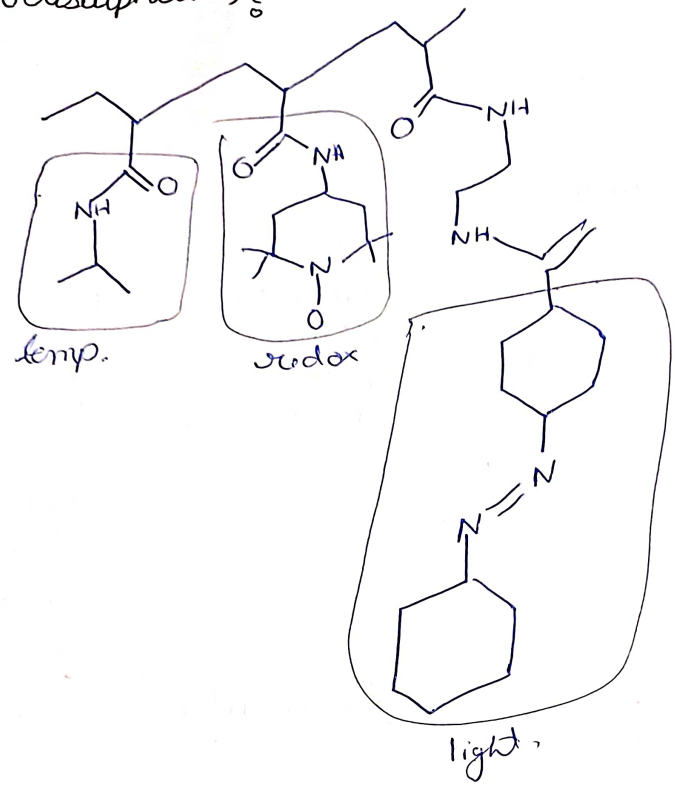
substain release ↓ slow release acc. to need

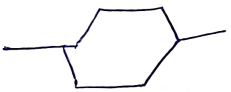
If burst happen, ie, trigger is so fast it can be fatal

for insulin ← (sugar, salt conc. can also be trigger)



thiodisulphide →?





29 | 01 | 2023

Doubt "creating" session. 1 - Feb - 2023

Tierce Exam → MCQ only.

25 Ques × 2

+2, −0.5

→ Atom transfer radical Polymerization

- Transition metal with variable oxid^n state.

Mn → 0, +2, ——— +7

Cr → 0, +2 ——— +6

Fe → 0, +2, +3.

Cu → 0, +1, +2

↳ at zero O.S. act as good catalyst (Nanop form)

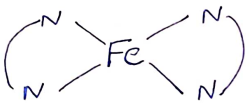
Ag → 0, +1

↳ act as catalyst,

homogeneous catalyst: can't separate (due to same state) → catalyst leaching

heterogeneous catalyst: can be separated,

tetracoordinated complex:



hexa coordinated

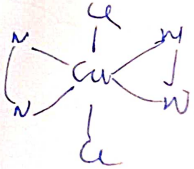
friedle craft alkylation → radical pathway.

$P_n{-}X + M^m/L_n \underset{Ka}{\overset{ka}{\rightleftharpoons}} \overset{\circ}{C}$ (CuCl, +1 → CuCl$_2$)

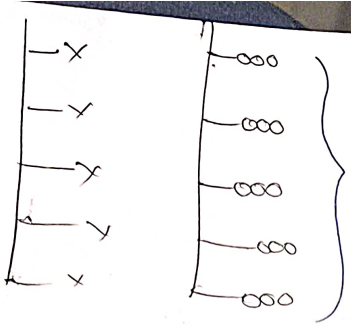
$\overset{\circ}{C} + \overset{\circ}{X}$

∴ 2 OS required.

ligand, satisfy coordination sphere. to make it stable.

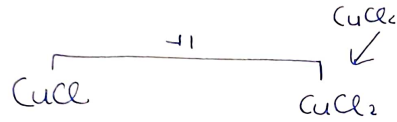


forward Rxn is made slow → controllable.



all chains grow similarly
less dispersed.
due to controlled Rxn.

ensure, at $t = -$ sec., all alkyl halide bonds are broken, → then propogation is same.
→ (initiation step is fast) (slow) - control - groth. of polymer, less dispersed



CuCl₂ (deactivator)
↓
eq. will shift to left side, hence control.
↓
Rate of propogation.

Role of

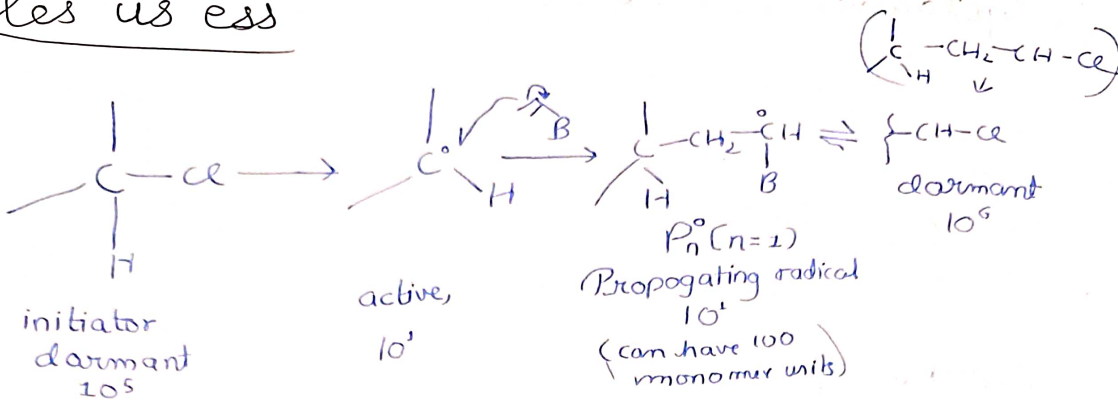
→ Role of Tn → under goes Ox.
trap halide

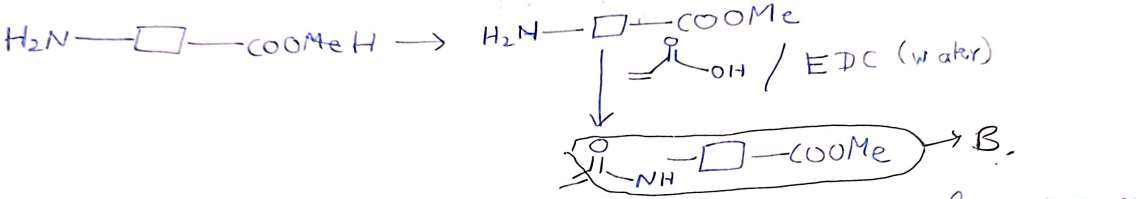
→ deactivator → conc. of activ radical is very low.
eqi. goes to left.

→ ligand → ensure T-X is stablized, by stablizing cordination number.

Note: In homogeneous catalysis, polymer traps the metal, in PPm make it useless for medical purpose.

les us ess





the aim is to
Reduce. Bimolecular termination, Disproportionation
$R_x - R_x$ / R^+ & R^-
(to make diblock co-polymer)

→ Technique for grafting polymer to a surface

(No. of molecule / nm^2 of area. GRAFTING density.)

∴ they repel, it is difficult to get high density of polymer by "Grafting to" start

∴ we use "Grafting from"

NH_2 COOH coupling, ester, thiol

Cycloaddition, Click Rxn:

silver sulphazide.

1. Esterification → by func initia.
2. Polymeric " "

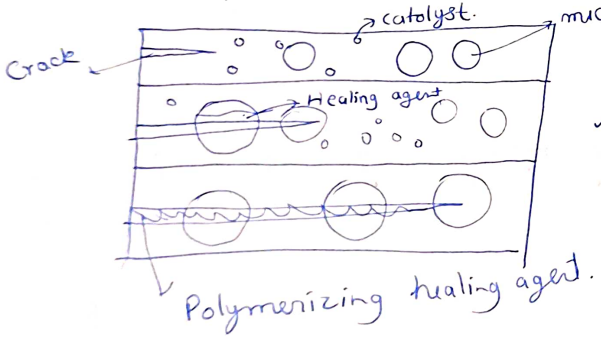
triazole → antifungal.

25/01/2023.

Self healing.

- Automatic without any external intervention. (Gecko)
- Non automatic external intervention required.

⇒ Via microsphere Embedement



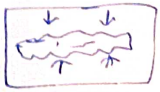
nano → micro →
10^{-9} 10^{-6}

↳ trigger. (system should sense)

healing material should not be too brittle.

↓

will not stick to the surface, it should reach the surface deeply before solidifying.



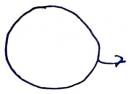
→ PROBLEM with this sys

- can heal only once, once microcapsule used, (consumed)
- cant be used again, multi-healing cant happen (no reversibility)

→ Dual capsule system (can't heal mult. times) (Healing agent lost)

IPR (Intellectual property Rights)

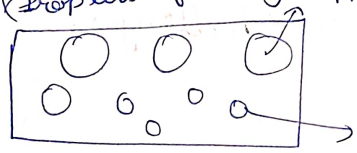
→ Wait a min... how does a capsule breaks ??



→ Wall made in such a way. nano crack can rupture them. (Pressure sesitive)

Now, back to topic.

(Droplets of healing agent HOPDMS + PDES) (1)



Catalyst di-n-butyltin dilaurate (DBTL) encapsulated in (polyurethane micro capsule) (2)

↓

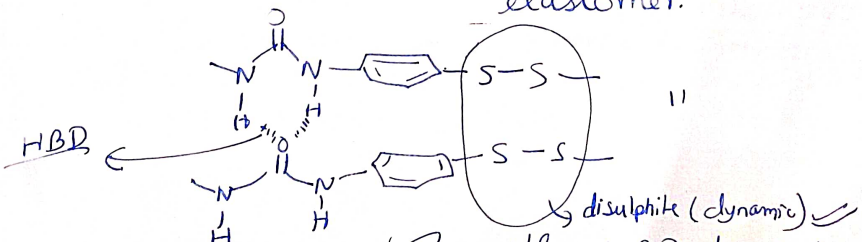
Withstand 24mPa pressure.

→ In 1st case, catalyst already present, Healing agent already start solidifying before reaching everywhere,

→ In 2nd case, catalyst (In PU) released late. Solidification starts late, ie after healing material reaches crack completely.

o Catalyst free, room temp. self healing elastomer

Self healing poly(urea-urethane) elastomer.



(Reversible) HBD dynamic.

SLIDE

Multiple healing possible

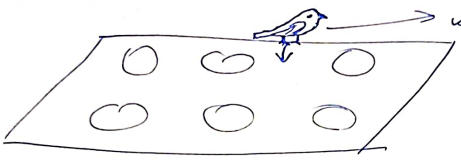
→ Smart, self healing coating

Scratch resistance self healing coating.

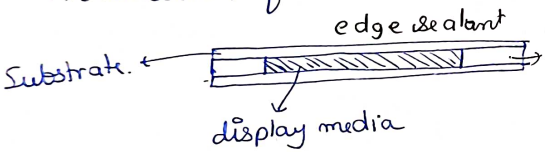
New scratches

One week later

o Photo voltaic Devices : Challenges.

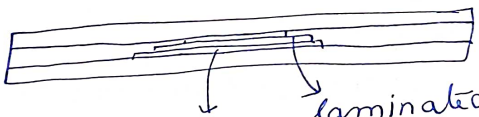


Protection from, moister/oxygen is needed.



↓ should be solvent free

→ material itself is fluid, & doesn't req solvent.



Provide flexibility to display.

laminating coating.

Inorganic.

~~YT = 1.~~

for screen { moister oxy.
external damage.
mechanical damage

SUMMARY,

we discussed HOW ?
this material works,
3 ex, 1 major application.
Mechno response, pressure → TRIGGER.

2nd ex : catalyst has delay release, Healing material reach & heal efficiently.
Catalyst → req. multiple trigger
Healing agent → singl trigger enough.

→ more no. of sites, faster healing, better healing
vanilic bond → best HBD, healing.

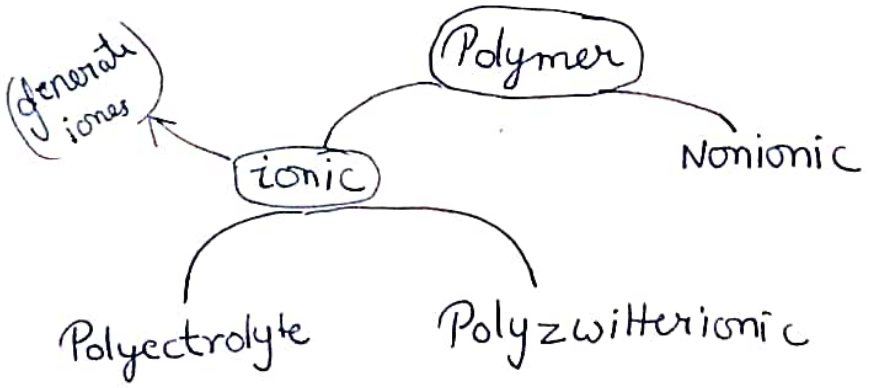
Why self healing adhesive, without solvant are more imp. → req. high barrier properties protec. moister,
for non-hazardous sys. → req. Solvant free. coating.

more imp. → req. ...
protec. moister,

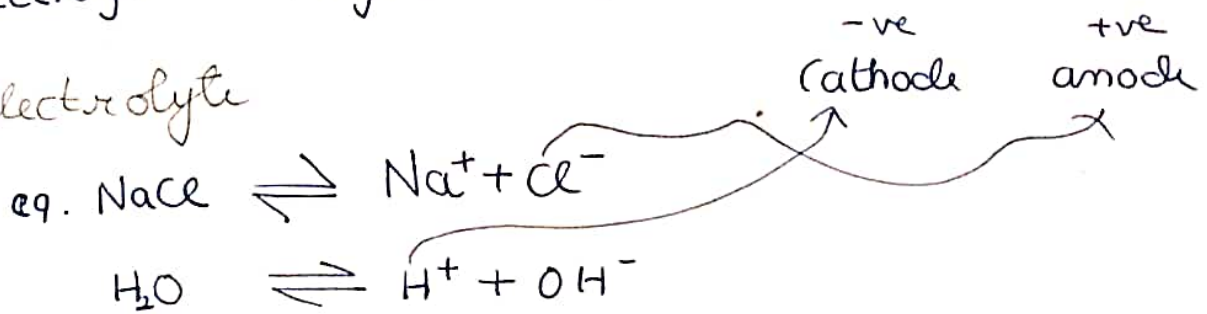
for non-hazardous sys. → req. Solvant free. coating.

31-01-2022

→ Zwitterionic polymer.

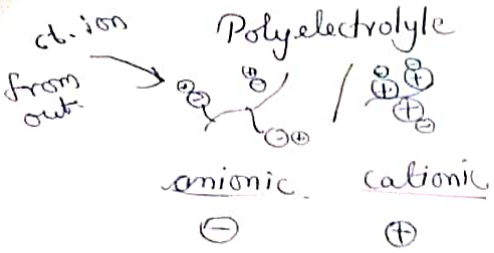


→ Electrolyte



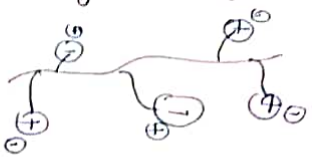
Solution conductivity vs zeta pt. → 0 → No net mig. of ion

surface charge



Polyzwitterion.

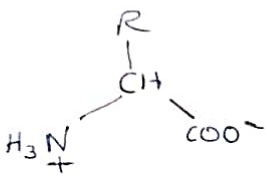
Polyampholyte



ex: $SO_3^-Na^+$ $CO_2^-Na^+$

↳ counterion exist in sol^n

at isoelectronic point ammino acid are zwitterionic.



have same no. of NH_3^+ & COO^-

∴ 0 zeta potential.

pH < 4 → polycationic (z+)

↓

cancer cell

∴ can use ammino acid as cancer ~~sensor~~ sensor,

→ Sensor ammino acid, monocat, mona anion, zwitter, ↓ atacidic

senzor → measure zeta

for healthy → 0

sharp jump → (+)ve zeta.

cancerous cell

how? ↓ endoscopy.

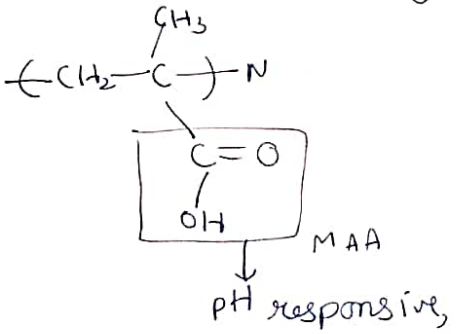
Biopolymer → ~~de~~ bioderived,

pH responsive material

- acidic group.

→ Drug release system

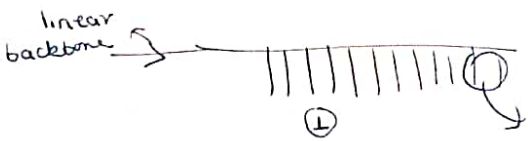
- controlled release of insulin
- hydrogel works as insulin containing reservior within P(MMA-g-EG) → graft polymer.
  - Methacrylic acid.



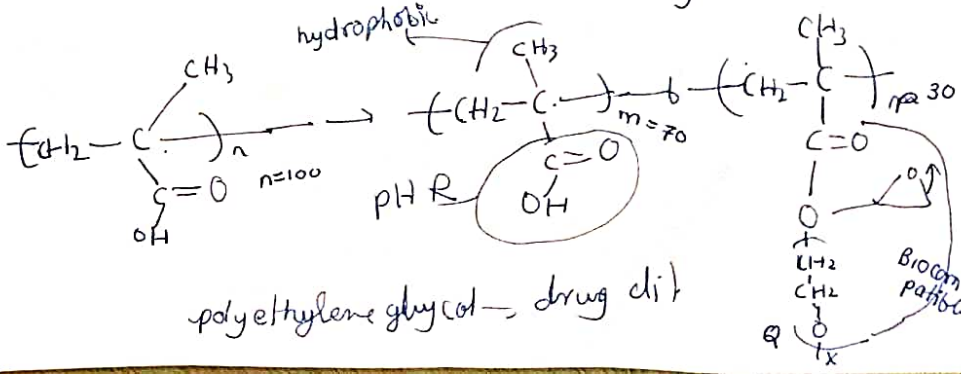
Biodegradable
pH responsive
compatible.

Normal pH, Glucose pH 7.4
Higher glucose pH 4.0

Graft copolymer



ester → breakable

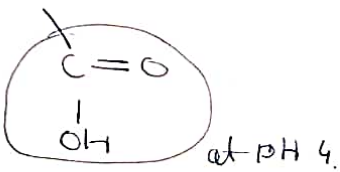


polyethylene glycol — drug dil

Increased glucose conc → pH ↓
trigger the is pH.

Insulin in miscelle encapsulation,

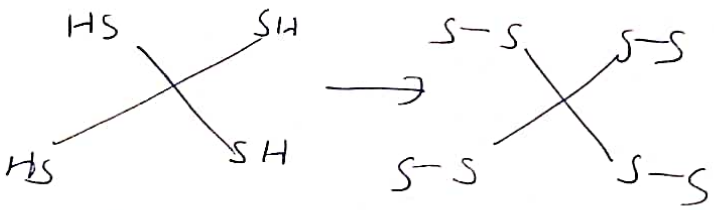
∴ at pH 4



at pH >4
COO^-, miscell formation,
ambiphilic.

pH<4 all COO^- protonated,
NO miscell,
Collapse release insulin.

→ Drug release syster.



Reversibly crosslinked
3D network

4D system ?

Yes! the ability to transform its shape

→ swell on water conc.

solvent, water, air, → swelling → controlable due acc. to env.

○ → can be turned. → can't be used, → its temp. resp.

ex: PNIPAAm, → crosslinked struct above LCST of homo polymer.

swell → encapsulate,

shrink → release.

SH — redox

– Cou → HP

–  → diol.

CD → host guest complexation.

counter of body should recognize. scaffold external.

→ cell Adhesion control. → used as tissue scaffold.

~~not~~ Blood stop ? → adhesive property.

○ Platelets on Polyethelene glycol grafted tissue. culture of ~~polymer~~ polystyrene (TCPS) retain a rounded shape at 37°C