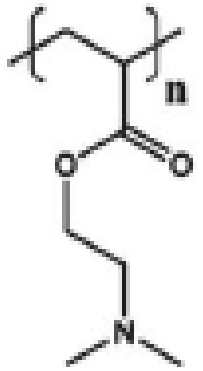
Double stimuli responsive polymers

1. Thermo and pH-responsive polymers
2. Thermo and light-responsive polymers
3. Thermo and redox-responsive polymers

1. Thermo and pH-responsive polymers

Example:- PDMAEMA



PDMAEMA

These materials attracted great attention in the field of drug delivery

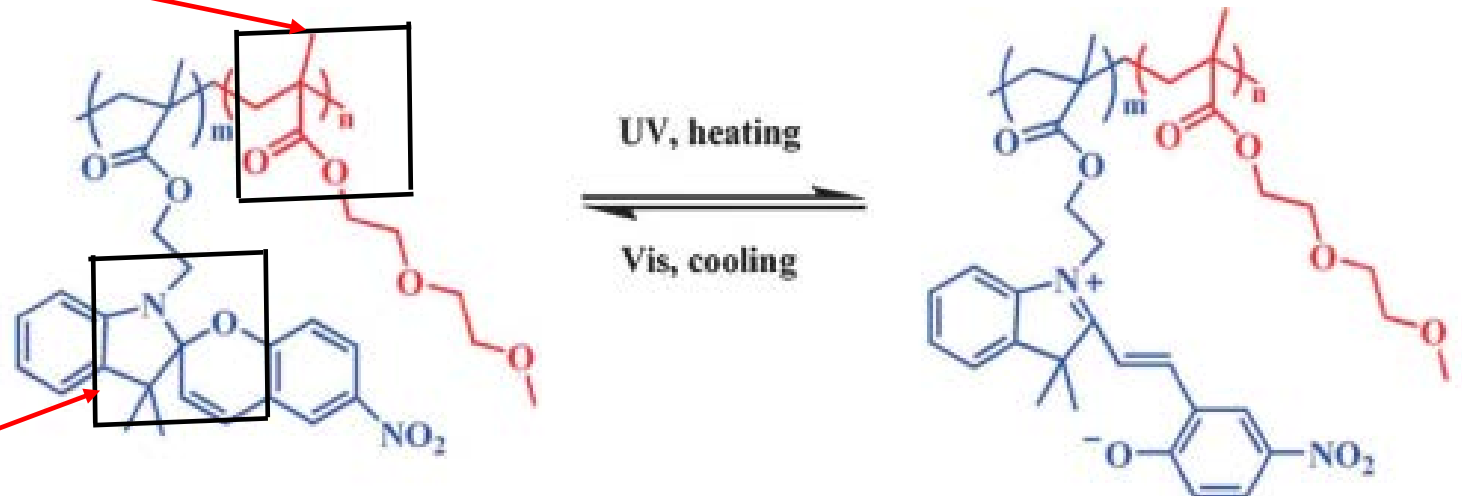
Ref: Schattling et.al *Polym. Chem.*, **2014**, *5*, 25–36

2. Thermo- and light-responsive polymers

Examples :-

1. Polymerization of N-isopropylacrylamide (NIPAM) with an N-(4-phenylazophenyl)acrylamide monomer.
2. Spiropyran containing methacrylate (SPMA) with di (ethylene glycol) methyl ether methacrylate (PDEGMMA)

Thermo-responsive



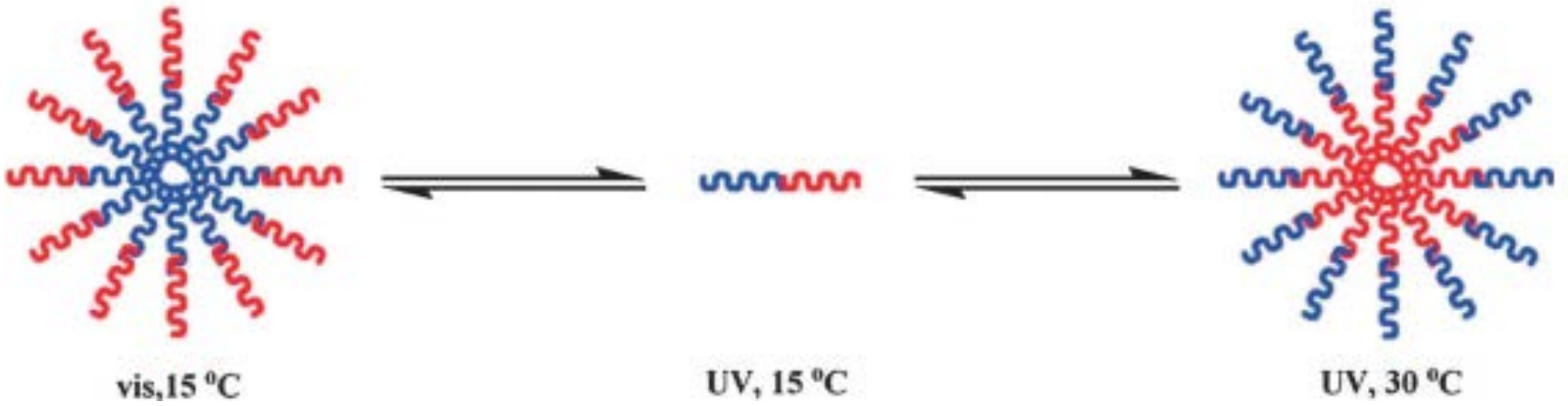
Light-responsive

Non polar, Hydrophobic & Colourless Polar, Hydrophilic & Colored

PSPMA-PDEGMMA

Ref: Jochum et.al *Chem. Soc. Rev.*, **2013**, *42*, 7468--7483

Double stimuli responsive polymers



PSPMA-PDEGMMA

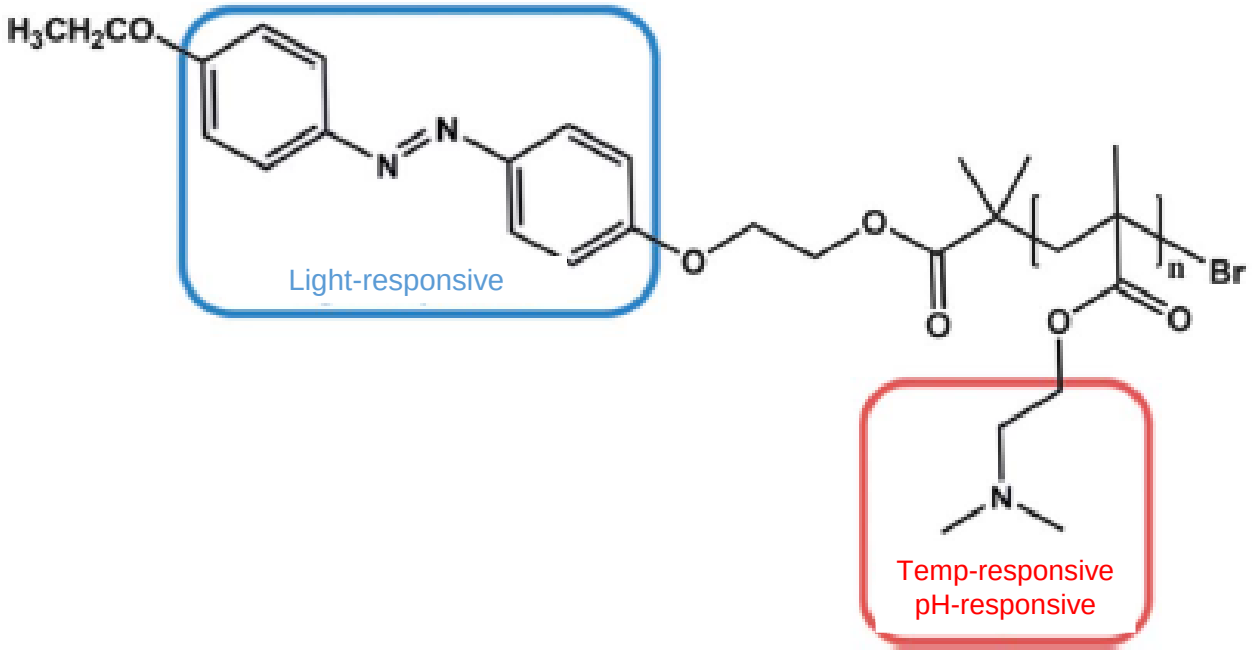
Micelles formed by changing the temperature (from 15°C to 30°C) of the solution and by photo irradiation. These micelles were used for encapsulation and controlled release and re-encapsulation of the model drug.

3. Thermo and redox-responsive polymers

The systems consist of PNIPAM macromonomers, which were linked via disulfide units, can be considered as a system with two stimuli having a causal impact.

1. Light, pH and temperature responsive polymers
2. Light, redox and temperature-responsive polymers
3. Environmental, pH and temperature-responsive polymers

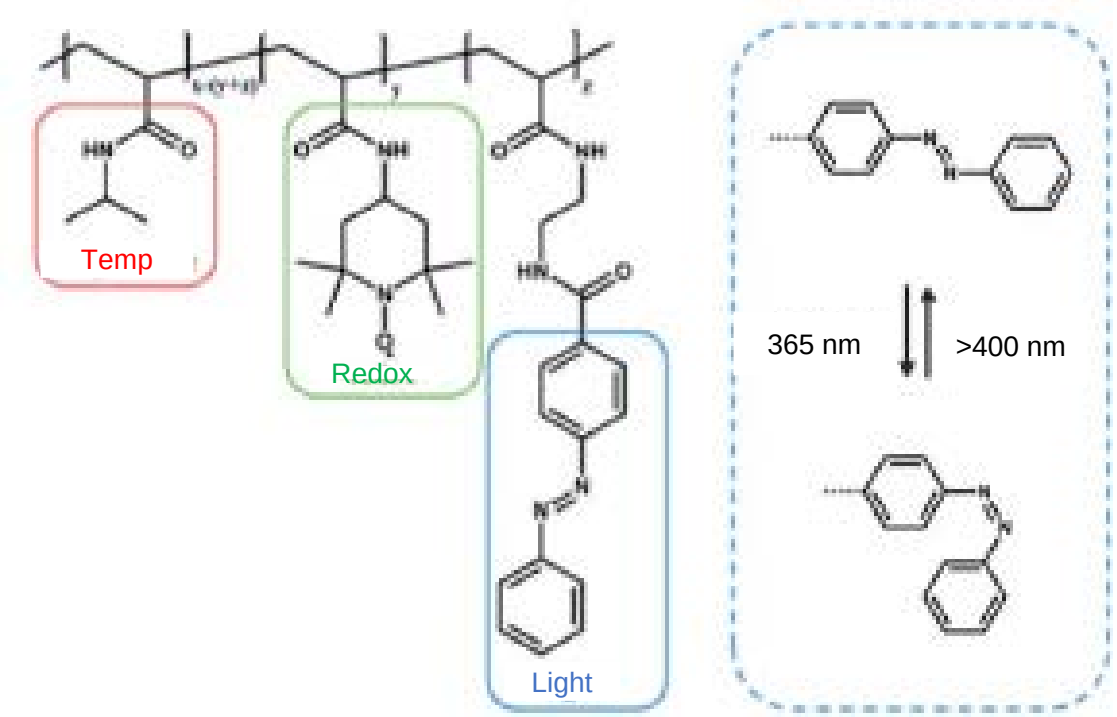
1. Light, pH and temperature responsive polymers



PDMAEMA polymer end-functionalized with azobenzene, which can be stimulated by light, temperature and change of the pH value.

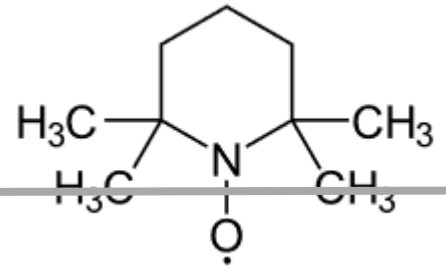
Ref: Schattling et.al *Polym. Chem.*, **2014**, *5*, 25–36

2. Light, redox and temperature-responsive polymers



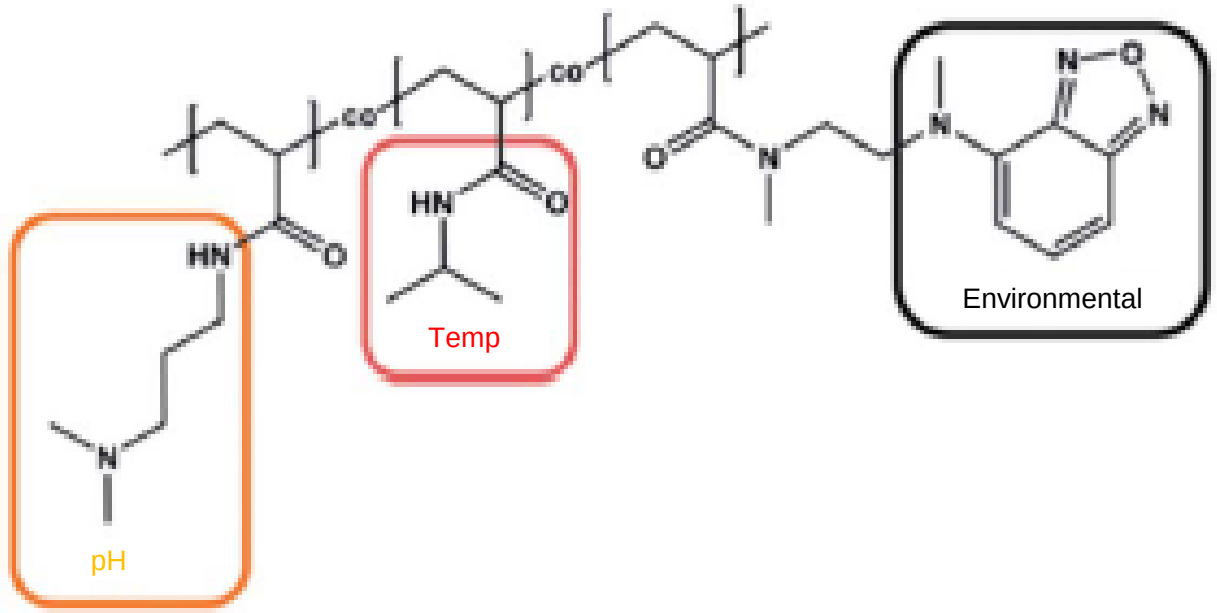
Triple-responsive polymer, equipped with the redox-sensitive moiety TEMPO, the light-responsive azobenzene and NIPAM, which is sensitive towards temperature.

(2,2,6,6-tetramethylpiperidin-1-yl)oxidanyl (TEMPO)



Ref: Schattling et.al *Polym. Chem.*, **2014**, *5*, 25–36

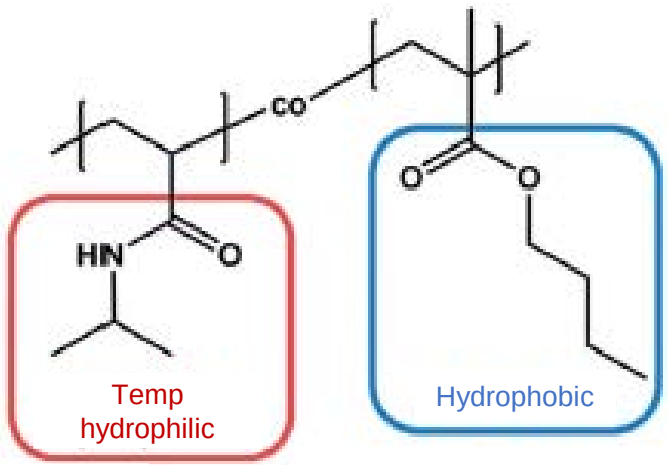
3. Environmental, pH and temperature-responsive polymers

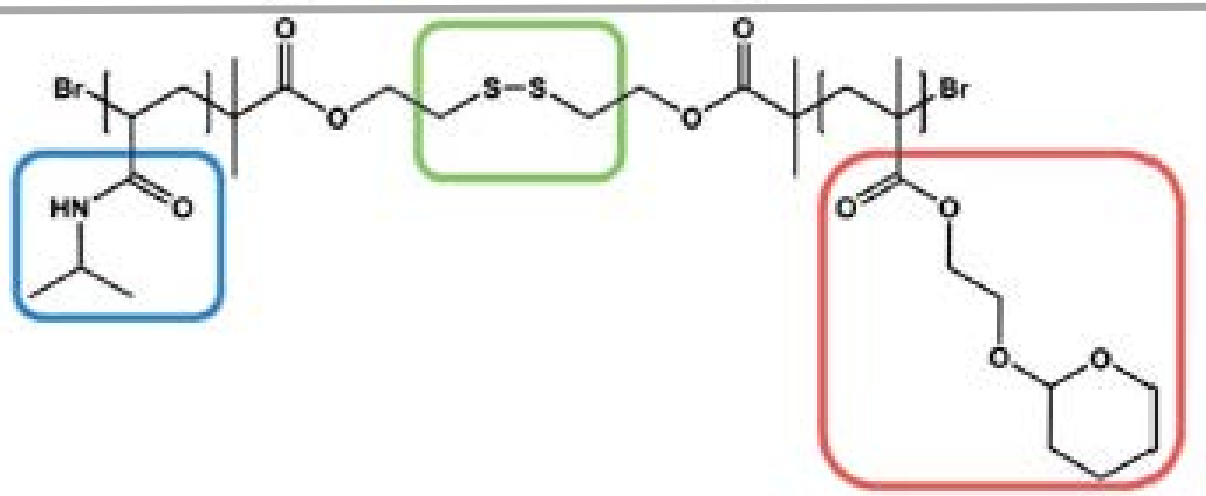


Stimuli responsive polymer system with causal interaction.

Ref: Schattling et.al *Polym. Chem.*, **2014**, *5*, 25–36

Responsive block copolymer architectures



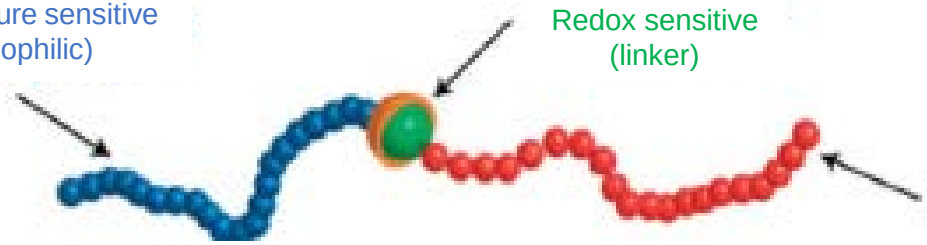


Polymeric micelle-drug

Drug release acceleration and adsorption enhance to cells

Temperature sensitive (hydrophilic)

Redox sensitive (linker)



Acid sensitive (hydrophobic)

Diblock copolymer based on PNIPAM and PnBMA investigated in the context of stimuli responsive drug delivery.

Triple-responsive disulfide linked diblock copolymer suitable for supramolecular self-assembly and external triggered disassembly.

Ref: Schattling et.al *Polym. Chem.*, **2014**, *5*, 25–36