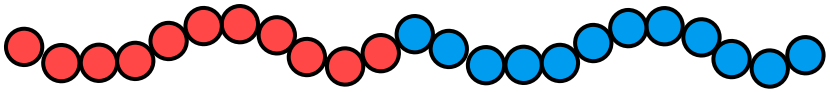
Research projects for MSc

Dr. Patrizio Raffa
Assistant Professor
Polymeric Products

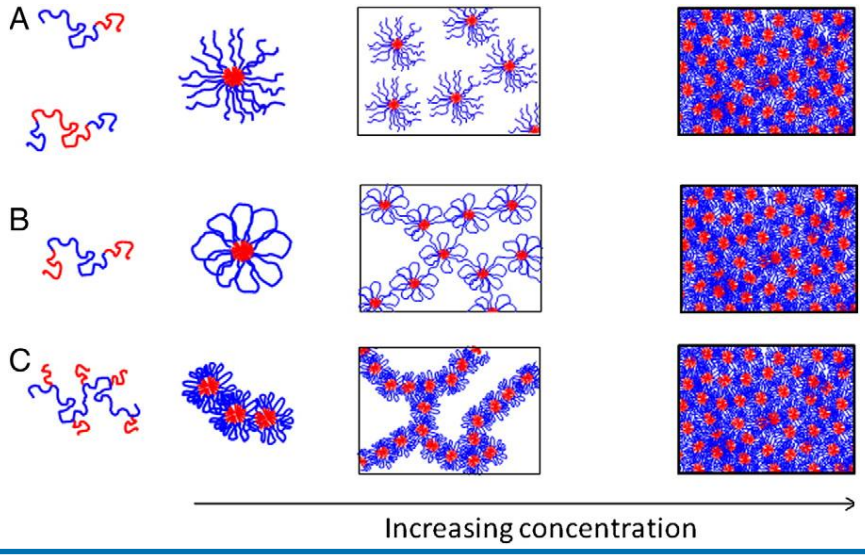
Polymeric Surfactants



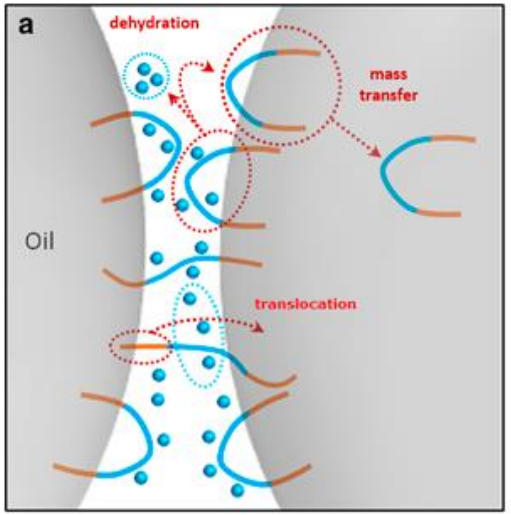
hydrophobic

hydrophilic

Rheology (viscosity) control



IFT decrease and Emulsion stability



Applications

detergents

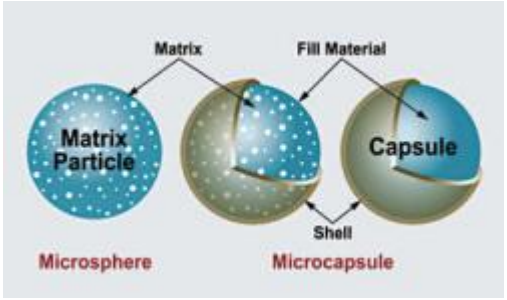
toothpaste

Hair gel

paints

Crop protection agents

Protective coatings



Micro- nano-encapsulation gels

Pharmaceutical emulsions

One special application

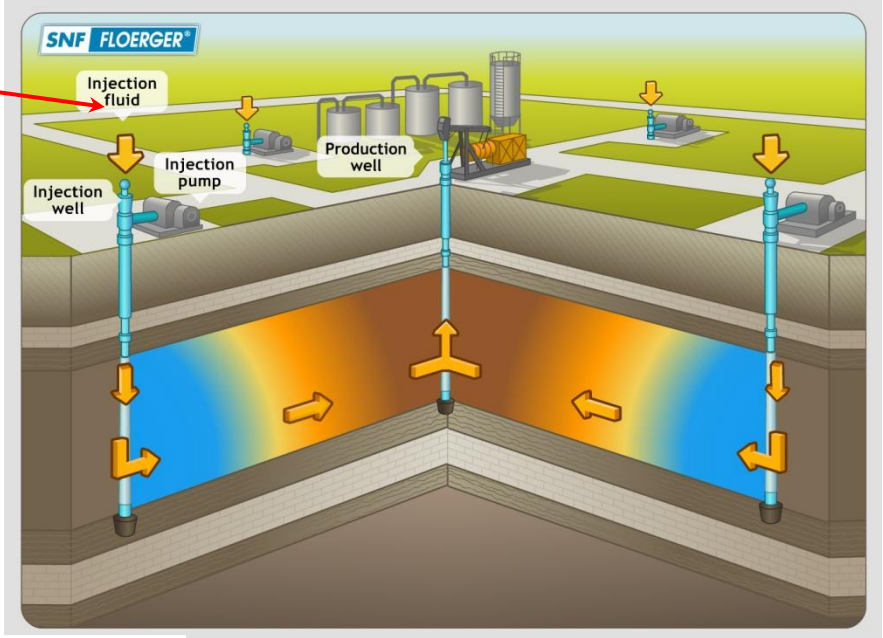
Oil recovery

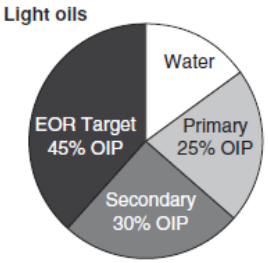
Primary

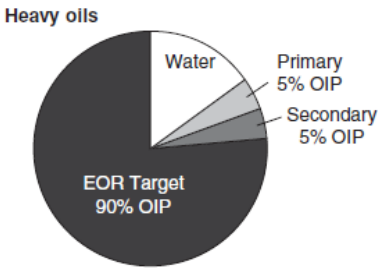
Secondary

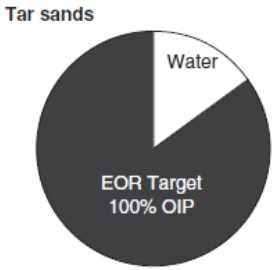
EOR

Steam injection
CO_2 injection
Polymer flooding
surfactant flooding
…







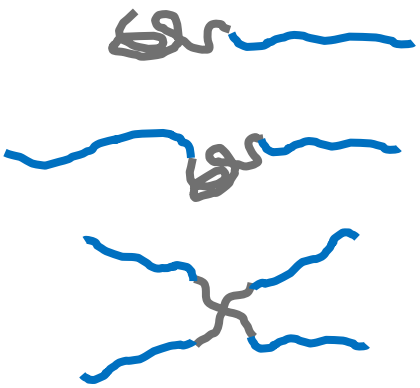


> 45% is still underground

Chemical… …Engineering

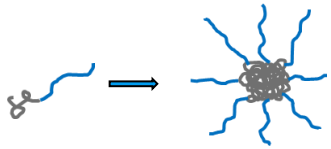
Synthesis

hydrophobic hydrophilic



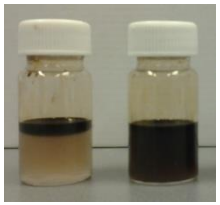
Properties

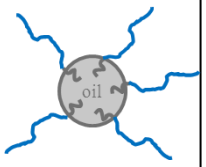
Viscosity enhancement



Emulsions stabilization

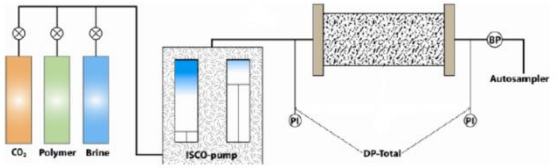
Commercial PAM





Polymeric surfactant

Application

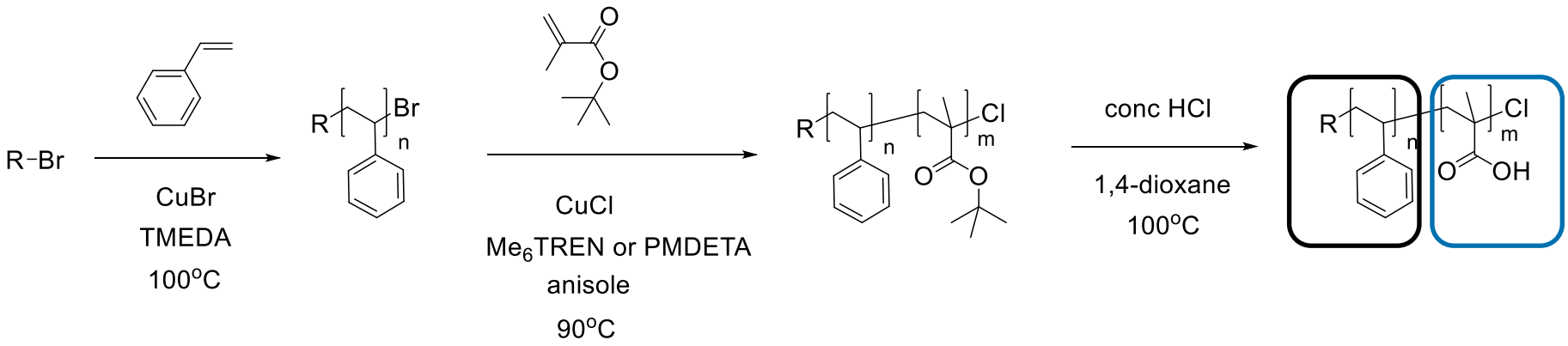


Prepare polymer with different structures

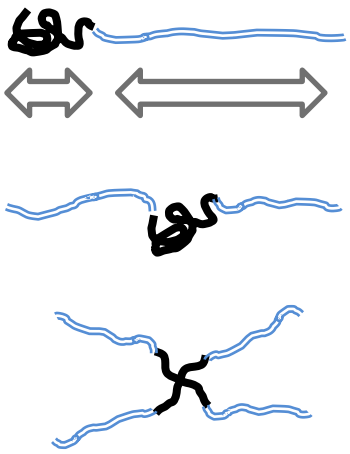
Measure the relevant properties (viscosity, surface tension, etc)

Simulated oil recovery experiments

Research on polymeric surfactants (1)



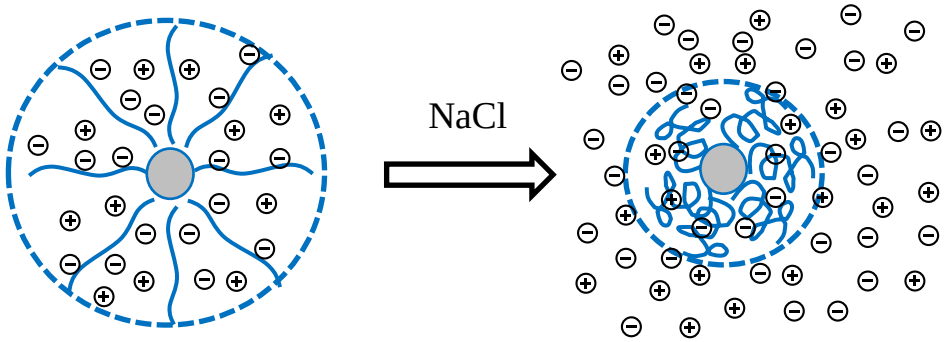
Structure-properties relationships
(*more fundamental research*)



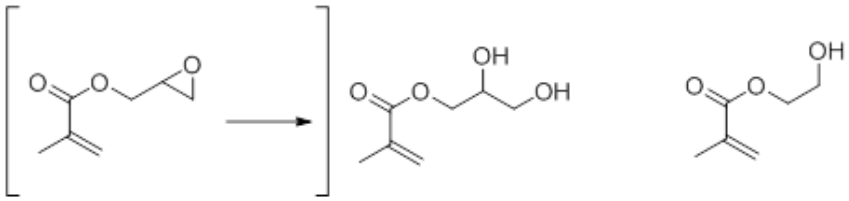
Synthesis → Rheology
Surface activity

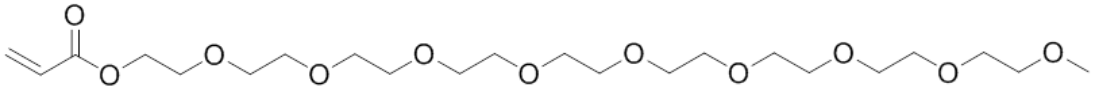
Research on polymeric surfactants (2)

Reduce salt-sensitivity
(*for EOR or other applications*)

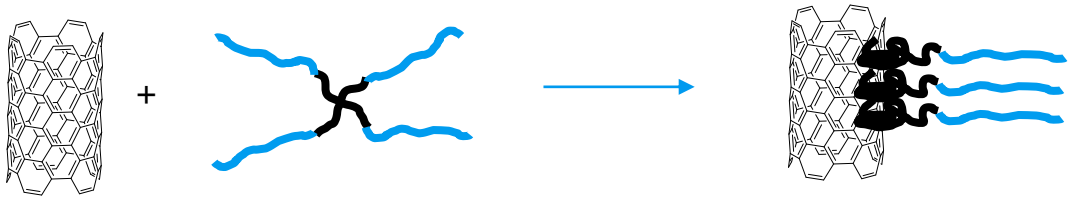


Use of neutral hydrophilic partners





Research on polymeric surfactants (3)



pH- salt-responsive

Water dispersion of CNT

coating

Partly bio-based polymeric surfactants

Introducing bio-based monomers
(*for more sustainable/green products*)

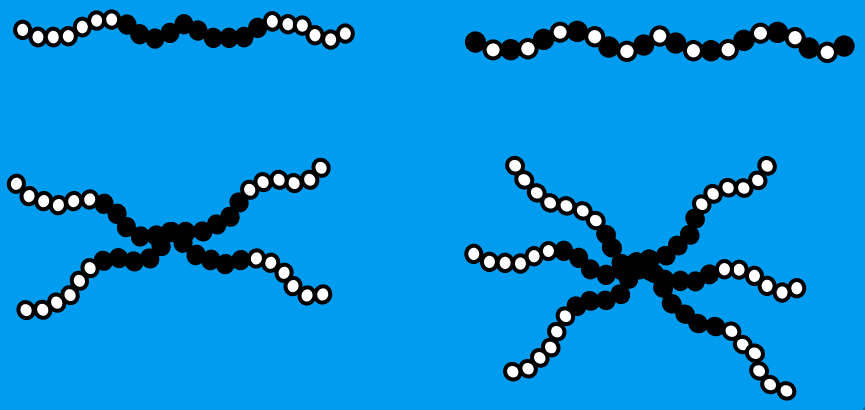
Waste from food industry

Sugar molecules → *Chemical modification* → Hydrophilic monomer → *(co)polymerization* → Polymeric surfactants

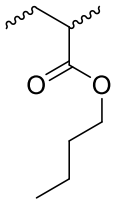
Industrial partners: ROYAL COSUN, CRODA, dalli group, nuplex

Research on thermoreversible elastomers

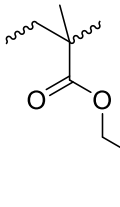
Controlled synthesis

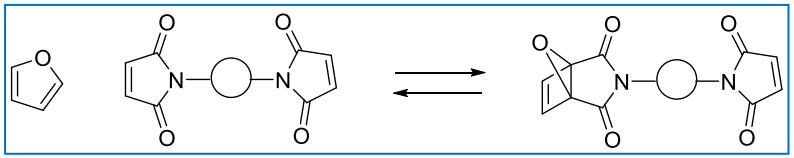


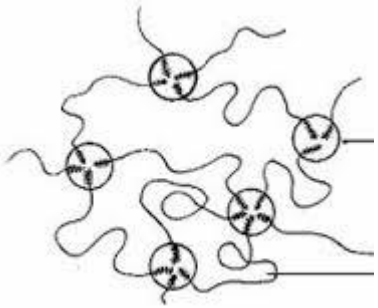
● Rubbery block (T_g ~ -50ºC)



○ Cross-linkable block (Diels-Alder)





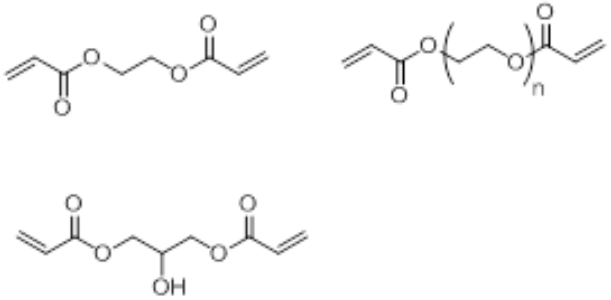


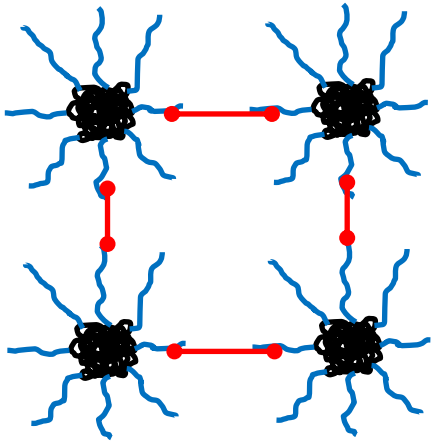
Rubber (SBS-like)

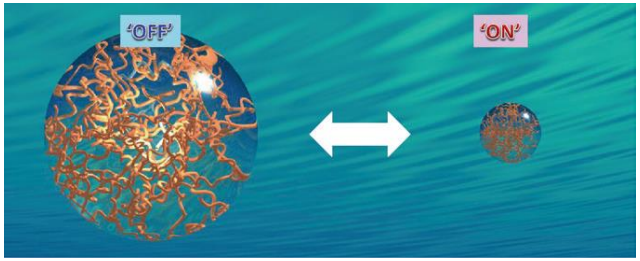
Goal: expand applicability window, optimize structure-properties

Preparation of "smart" hydrogels

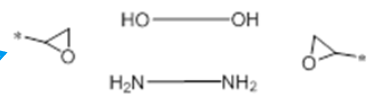
Use of difunctional monomer during polymerization



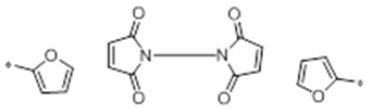




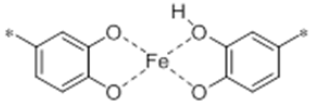
Post-synthetic gelation



irreversible

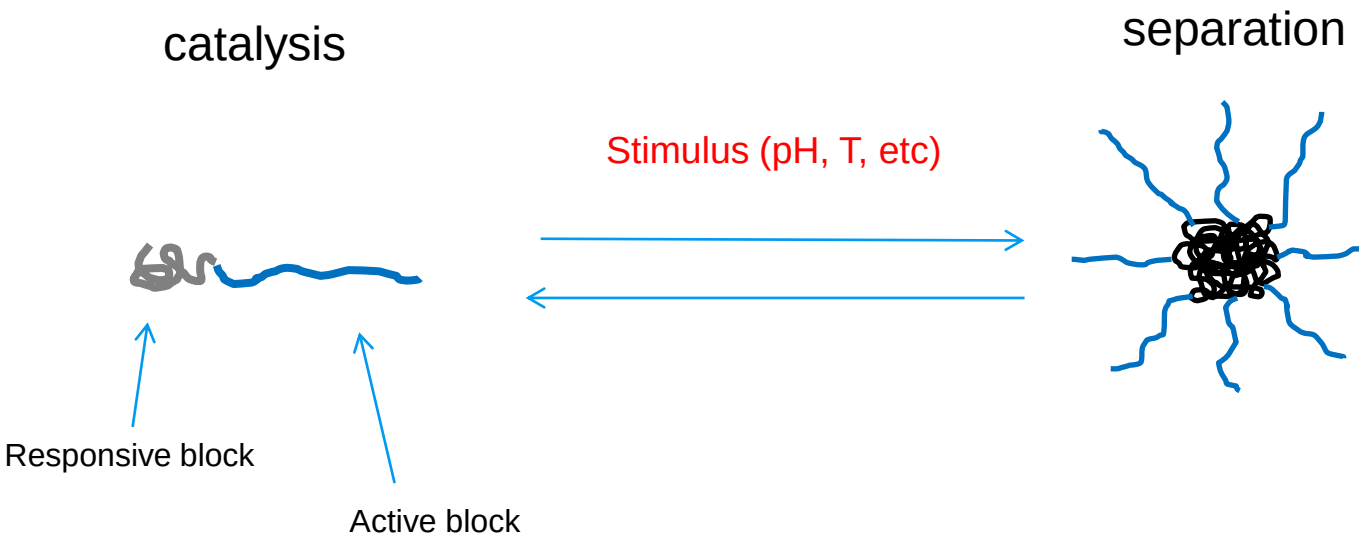


reversible



Catalysis with "smart" polymers

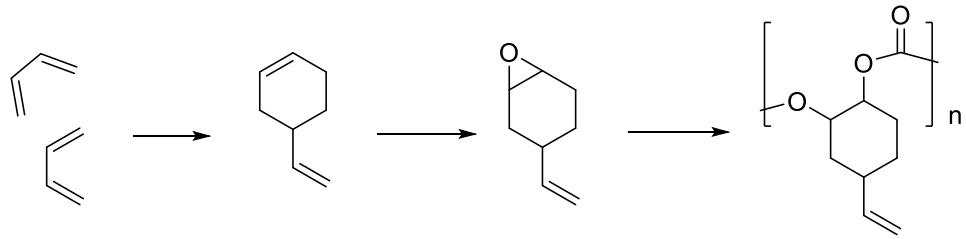
› With P. Pescarmona

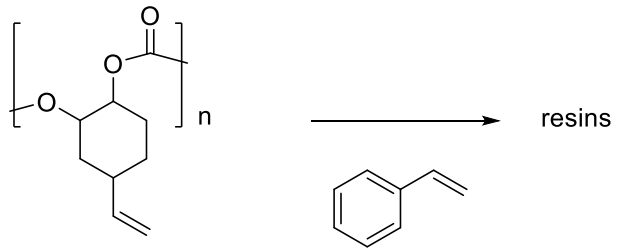


Also possible complexes and aggregates with metals / metal nanoparticles

Bio-based PC resins

› With P. Pescarmona

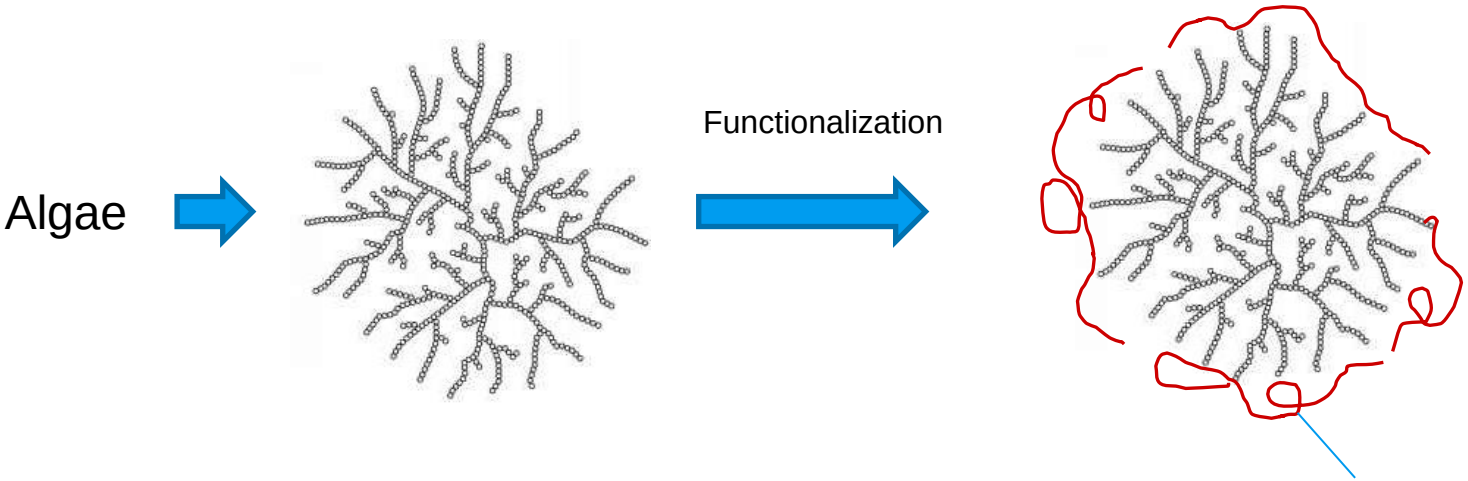




resins

New glycogen-derived functional polymers

› With M. van der Maarel



Possible application: Dispersion of hydrophilic compounds (e.g.: dyes) in hydrophobic polymers (PP, PS, etc)

Enzyme recognition/immobilization

› With some biologist

Preparation of metal-sugar complexes

› Functional hydrogels
› Catalysts

Amphiphilic polymers / metal NPs

› Functional hydrogels
› Catalysts

Contacts

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