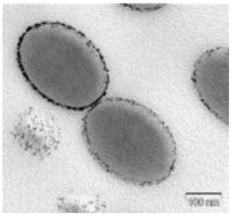
Team "PHYSICOchemistry of Polymers"

Leaders **Pole PHYSICO**

A. Charlot (Assist.Prof., INSA), C. Jegat (Associate Prof., UJM),
C. Ladavière (CNRS Senior scientist, UCBL)

14 PERMANENT STAFF

Understanding & **Control** of **interfacial interactions**



- **Colloidal suspensions**
  - by self-assembly, emulsion, interfacial polymerization, nano-precipitation, coacervation: *capsules (O-O or I-O), particles, coacervates, liposomes, metal-oxo cluster assemblies, nano- and micro-gels, complex fluids (such bitumen)*

- **Polymer/nano-structured surface-based films/coatings**
  - Functionalization ways: *grafting from/onto, LbL films, dip, spray, spin-coating, Langmuir-Blodgett films*
  - Nano/micro texturation by photopolymerization and phase separation (solvent, CO_2-sc)

- **Multi-component/multi-phase systems** *via* the control of interactions
  - in solvent medium: *hydrogels, ionogels, organogels*
  - at molten state: *polymer blends, multilayer systems*
  - at solid state: *particles and modified fibers, O/I hybrids, copolymers self-assembly*

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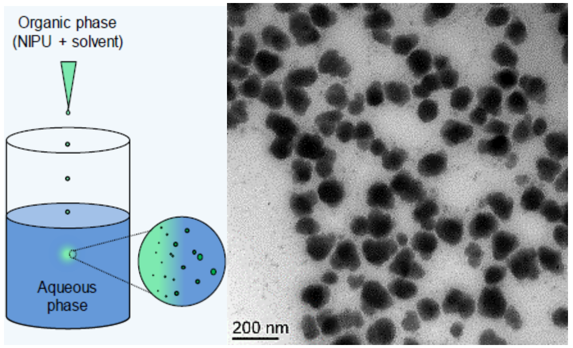
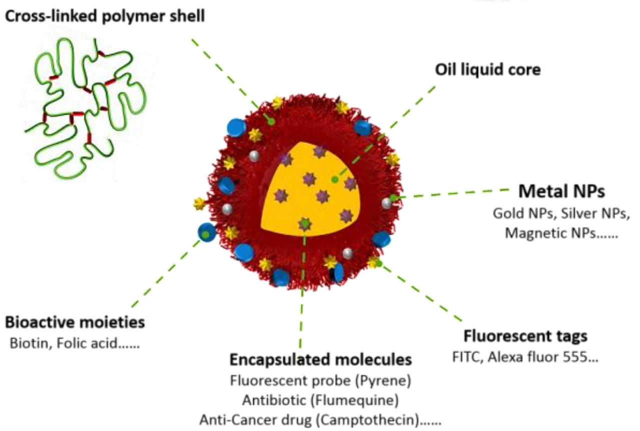
- ## Colloidal suspensions

Concept and functionalization



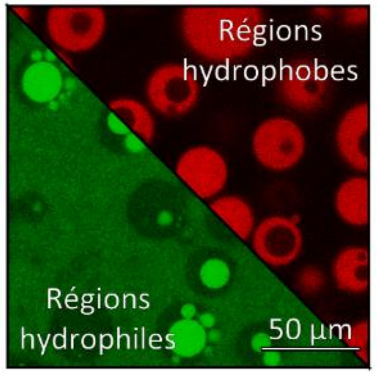
Nanoparticles of poly(hydroxyurethane) synthesized from biosourced monomers by nanoprecipitation

Sintes-Zydowicz *et al.*
European Polymer Journal, **2019**, 114, 434
Sintes-Zydowicz *et al.*
Colloids and Surfaces A, **2020**, 589, 124371



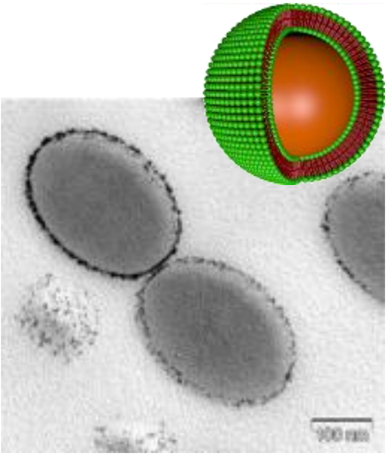
Multi-functionalized nanocapsules by solvent displacement

Bernard, Ganachaud *et al.*
Angew Chem-int Ed, **2014**, 53, 6910
Chem. Commun., **2017**, 53, 1401
ACS Appl. Mat. Interf., **2018**, 10, 25154
Biomacromolecules, **2019**, 20, 3915



Multiples microcapsules by phase inversion

Ganachaud *et al.*
ACS Appl. Polym.Mater **2021**, 3, 1707



LipoParticles by assembly of particles and liposomes

Ladavière *et al.*
Langmuir, **2005**, 21, 1305
J Control Release, **2017**, 256, 121
J Colloid Interface Sci, **2019**, 534, 105

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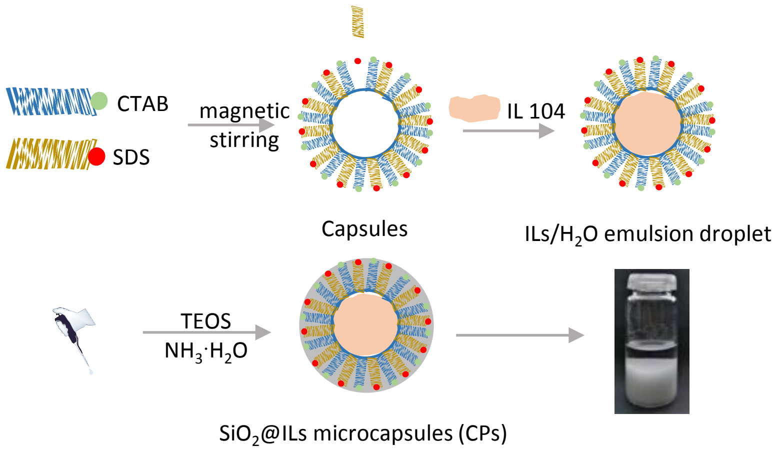
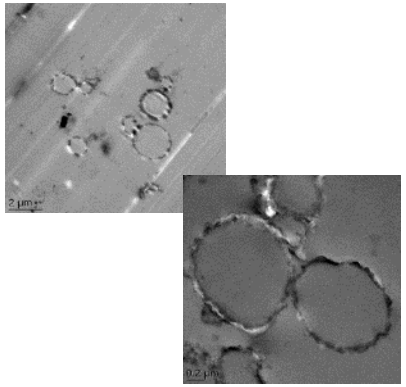
- ## Colloidal suspensions

Concept and functionalization

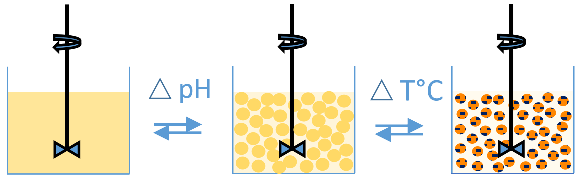


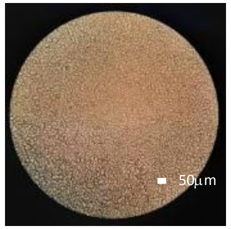


Microcapsules of silica with a core of ionic liquid

Livi, Duchet, Gérard et al,

Nanomaterials, **2020**, 10(5), 881

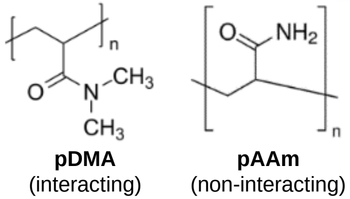


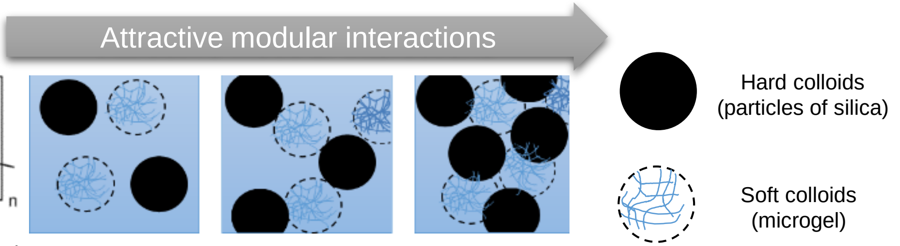


Complex coacervates and microcapsules

Jegat *et al.*

Projet « Appui au Développement de l'Enseignement Supérieur Français en Afrique »





Binary suspension of « soft and hard » colloids

Biosourced macro- and micro- gels

Dutertre *et al.*

Projet ANR BioCoCo

Projet IMPulsion CoMoCio

Thèse MESR A. Mungroo

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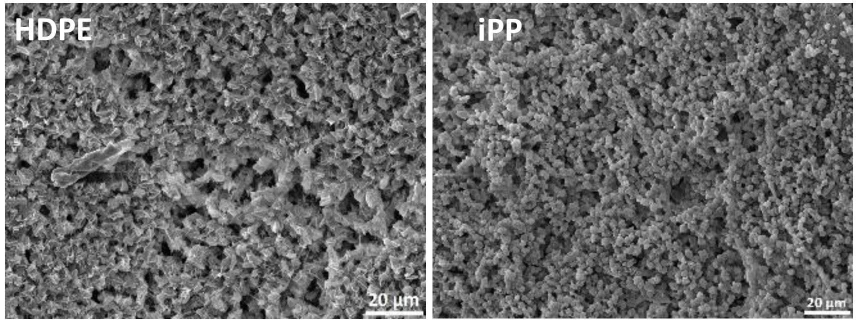
• Polymer/nano-structured surface-based films/coatings

Superhydrophobic films:

- Based on polyolefins by phase separation

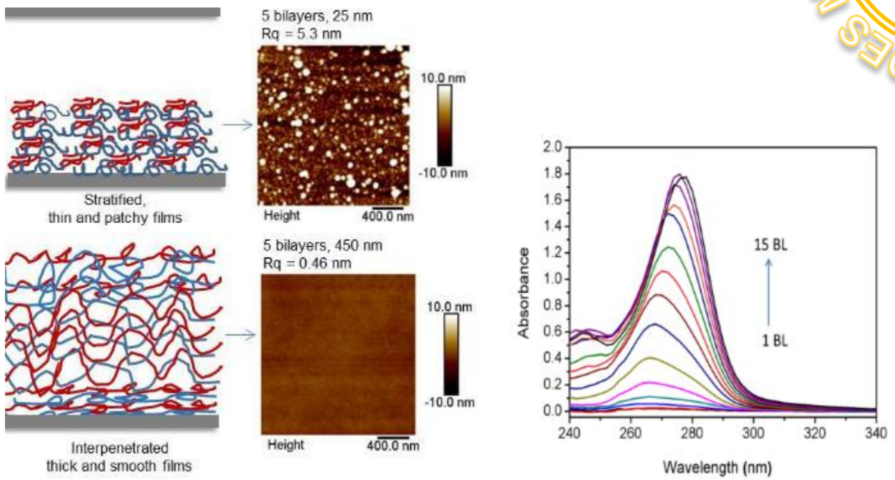


Texturation by exposure to solvents and recrystallization

Duchet, Livi, Gérard et al.

Soumis à Applied surface science, **2022**

Multilayer films LbL stabilized by hydrogen bonds



LbL film of hydroxylated or carboxylated poly(penta fluorostyrene/P4VP

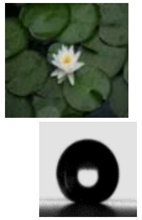
Charlot, Duchet, Portinha et al.

Langmuir, **2014**, 35, 10740 *European Polymer Journal*, **2019**, 117, 188

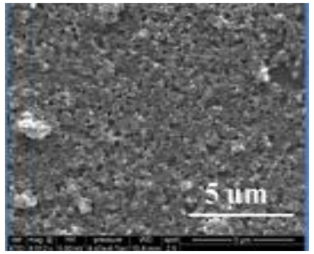
- From fillers/polymer matrix association

PUA/ silice

Cassie-impregnated regime



Cassie-Baxter regime



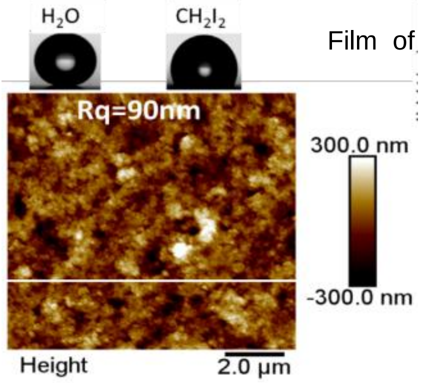
50 % silica : "Pétale" effect

60% silica: "Lotus" effect

Charlot, Galy, Gérard et al.

Polymer, **2018**, 155, 1

Poly(pentafluorostyrene) / modified silica PPFS



Film of PPFS-PFDT (DS = 29 %)/SiO_2-PS-PPFS (46 wt%)

Charlot, Beyou, Portinha et al.

European Polymer Journal, **2018**, 102, 120

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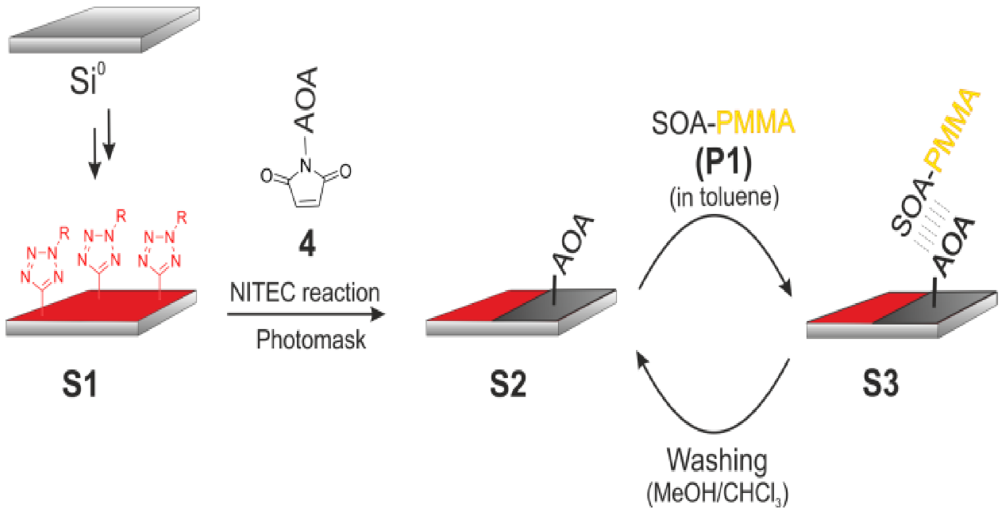
- **Polymer/nano-structured surface-based films/coatings**

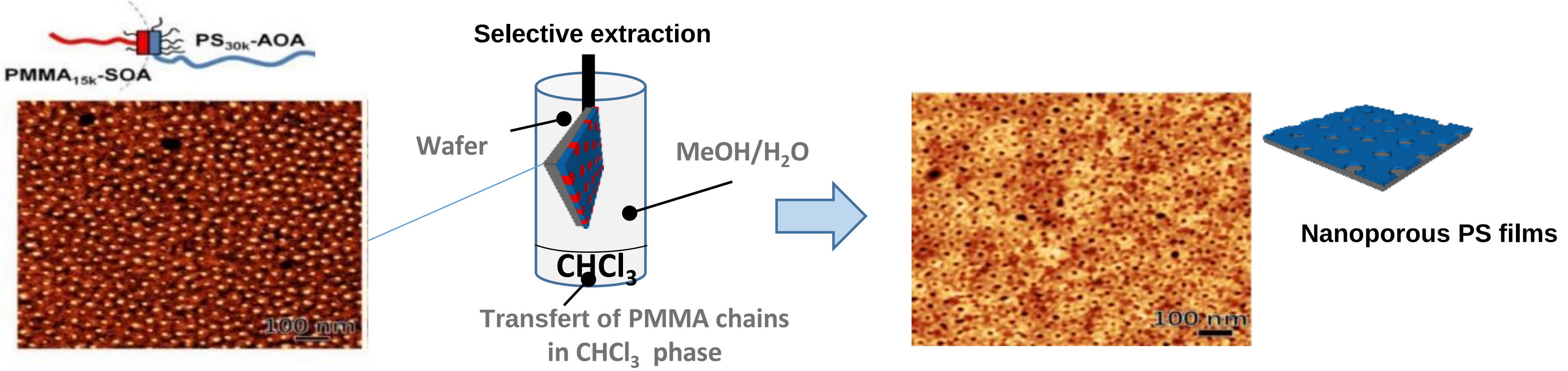
- By "grafting onto" **"Rewritable" surfaces**



Bernard et al.
Chem, Commun, **2016**, 8753

- By phase separation

Nanostructured/nanoporous films from the self-assembly of supramolecular block copolymers



Bernard et al.
Angew Chem Int Ed, **2015**, 54, 11117

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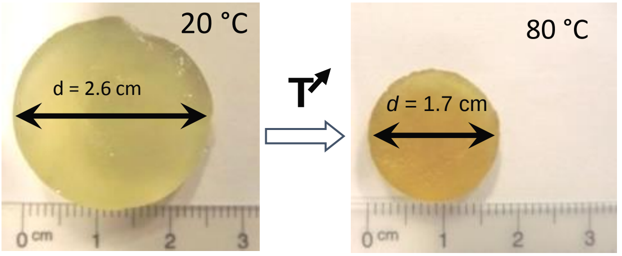
- **Multi-component/multi-phase systems**

  - *via* the control of interactions in solvent medium: hydrogels, ionogels, organogels

Chemical or physical hydrogels based on polysaccharides (modified or not)



Guar-based thermosensitive physical gels

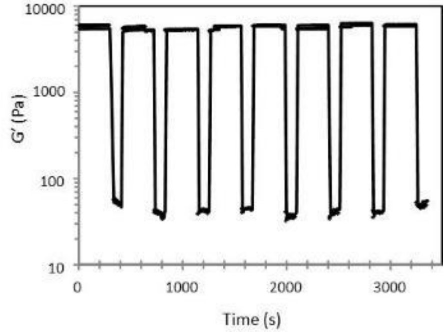
Charlot, Drockenmuller, Fleury et al.
Macromolecules, **2010**, 43, 6843 *J. Polym. Sci. Part A*, **2010**, 48, 2733

Polysaccharidic/ionic liquid or deep eutectic solvents ionogels with modular properties

Behavior solid

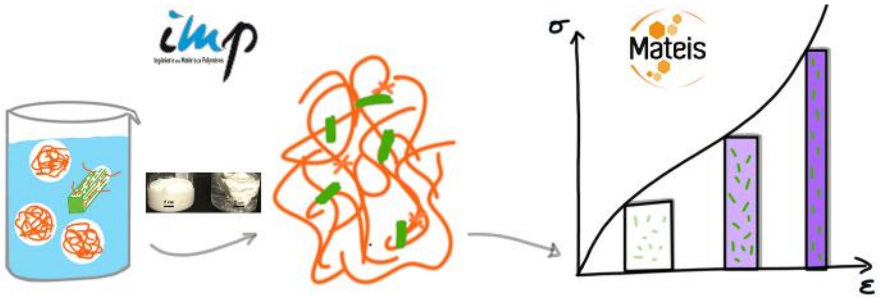
Ionogel guar/BMIMCl

Self-supported film



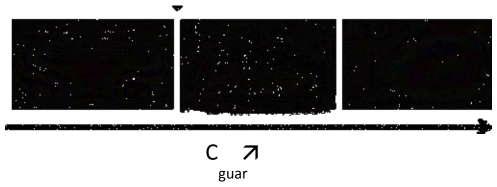
Charlot, Fleury, Bernard et al. *Carbohydrate Polymers*, **2017**, 157, 586
Carbohydrate Polymers, **2014**, 102, 932

Nanocellulose-loaded elastomers

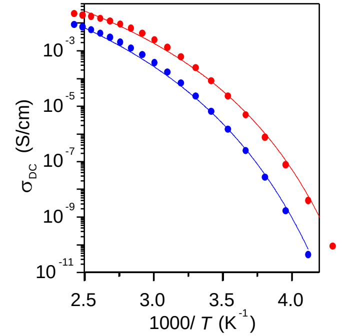


Fumagalli et al.
Soft Matter, **2018**, 14, (14), 2638

Biosourced Guar / ChCl-Urea mixtures



Ionic conductivity



Charlot, Sudre, Fleury et al.
ACS Sustainable Chem. & Eng., **2019**, 7, 19, 16747

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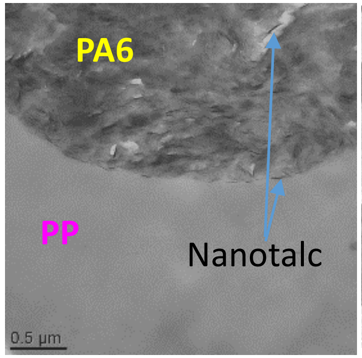
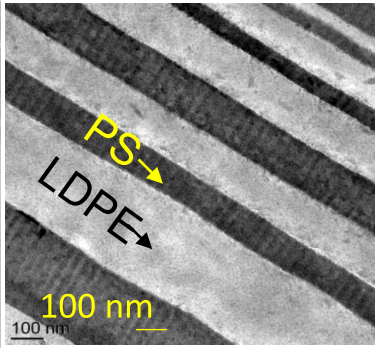
• Multi-component/multi-phase systems

- *via* the control of interactions at **molten state**

Nanofillers/polymer interfaces and multilayer films



TEM Nanotalc-4%/PP/PA6

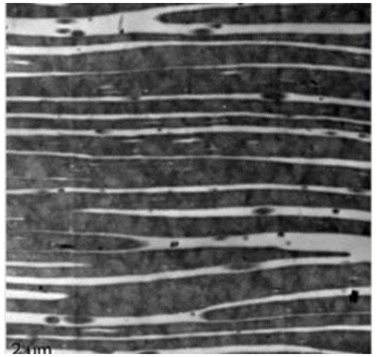


TEM PS/LDPE (50/50)-2048 layers

Yousfi, Livi , Duchet et al.

Journal of applied polymer science, **2014**, 13, 131

Bio-based materials with controlled biodegradability



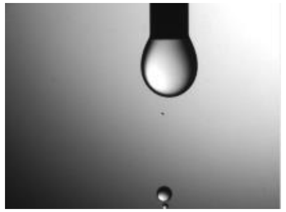
TEM PBS/PLA with deep eutectic solvents

Livi et al

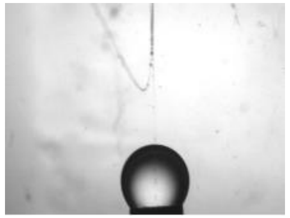
2019, **2020**

https://doi.org/10.3389/fmats.2020.00007 (2020).

Interfacial tensions at molten state



Drop of phosphoniumonic liquid in PDMS.

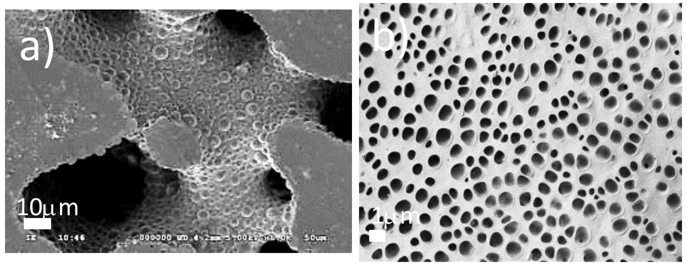


Drop of PIB in PDMS

Yousfi, Duchet , et al.

Polymer Testing, **2021**, 107280

Micro-reservoir porous materials



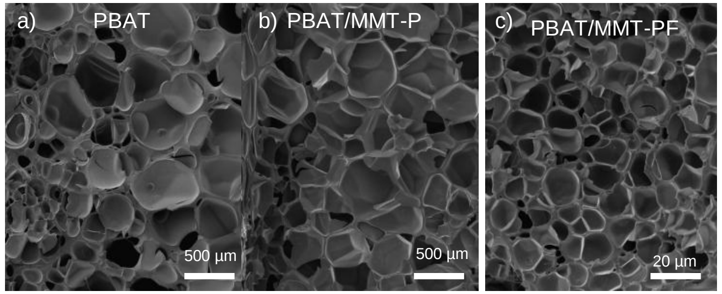
SEM a) Mixtures of PCL/PEO/PS reservoirs, b) PCL/PEO/-templates of reservoirs of vegetal oil

Jégat et al

Eur. Polym. J. **2017**

- *via* the control of interactions in **solid state**

Foam: pores modulated by MMTs modified by CO2-philic fluorinated LIs

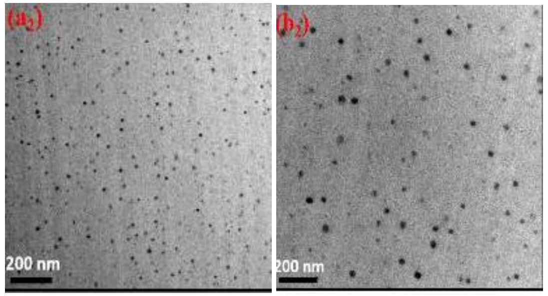


Livi, Duchet, Gérard et al.

Chemical Engineering Journal, **2014**, 240, 534

ACS Sustainable Chemistry & Engineering, **2016**, 4, 461

Design of nanostructured hybrid O/I networks



TEM of networks epoxy O/I hybrids :
a) IL CL-g-POSS, b) IL NTf2-g-POSS

Livi, Duchet, Gérard et al.

European Polymer Journal, **2019**, 114, 332

Polymer, **2021**, 224, 123721