
Ecole Polytechnique
Fédérale de Lausanne
EPFL
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Laboratory for Processing of Advanced Composites

Created: 2016

Direction: V. Michaud, P.-E. Bourban, Y. Leterrier

Staff: +20 members incl. Postdocs, PhDs, engineers, master students

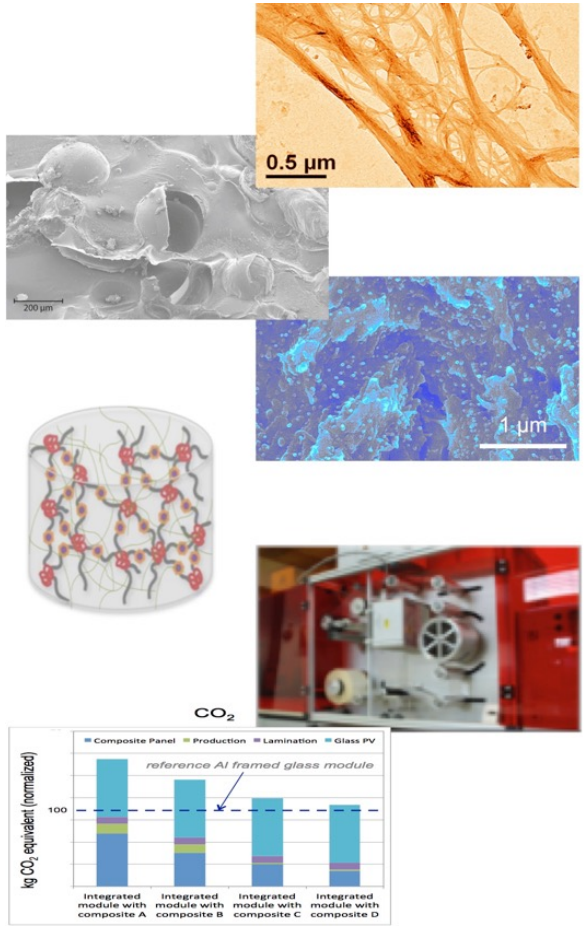
lpac.epfl.ch

Research at the LPAC addresses fundamental questions related to the manufacturing of polymer-based composite and multilayer materials

- Fundamentals of polymers and composite materials processing (multiphase fluid flow, capillary effects, process kinetics, UV and thermal curing)
- Surfaces and interfaces (bioinspired surfaces, adhesion and bonding)
- Integration of functions (smart and piezoelectric composites, self-healing ability, damping, non-linearity, biocompatibility).

Laboratory for Processing of Advanced Composites

- Processing of high performance composites
- Technical, economic and environmental coupled optimisation of materials and processes
- Smart composites
- Cellular (bio) composites
- Multilayer films & hybrid nanocomposites
- Bioinspired surfaces



Main partners and sponsors

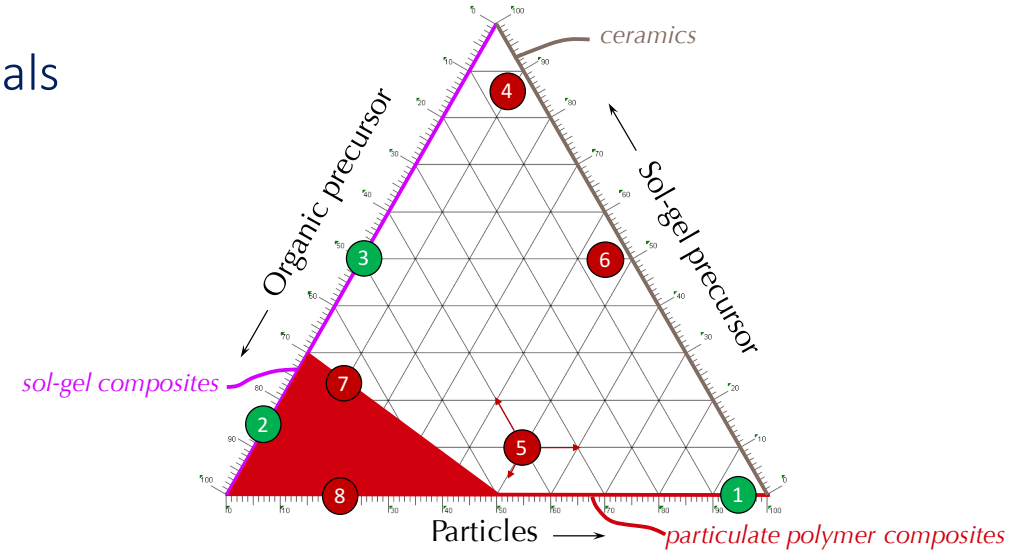
Over 100 contact points in Switzerland, in Europe and the whole world, with laboratories and industries in the fields of automotive, aeronautics, space, energy production and storage, mechanics, biomed, electronics, food, microtechnologies and sports.

- Swiss National Science Foundation, CTI-Innosuisse, SCCER, OFEV, OFEN, Interreg, PNR 62, CCMX, EU (Hivocomp, Encomb, JTI Clean-sky, DREAM, Momentum, Flexled, Flexidis)
- ABB, Alinghi SA, Applied Materials, Asulab, Bekaert, Bobst, Brugg, Buhler, CEA, CICR, Comelec, Décision, Dow, ESA, EMS-Chemie, Essilor, Essential Med, Exeger, Firmenich, Flyability, Hydroptère, Hydros, Konarka, LNI, Nestlé, Novelis, NTPT, Solar Impulse, Ruag Space, Solvay, Philips, Stockli Swiss Sport, Pomoca, RISE, Rolic, Samsung, SBB, Stora Enso, Solvay, SwissInso, Tetra Pak, Thales Alénia Space, Vetrotex …

Multilayer films & hybrid nanocomposites

- Integrative synthesis strategies
  - Photopolymerization & sol-gel dual cure processes
  - Interfacial engineering and process rheology
- Gas-barrier films and encapsulation materials
  - Food and pharma packaging
  - Flexible electronics (OLED, solar cells, batteries)
- Multifunctional coatings & surfaces
  - Self cleaning, antifouling, antibacterial
  - Light-trapping (antireflective, scattering)
  - Superhard, piezoelectric, conducting, magnetic
  - Functionally graded
  - Self-repair
- Mechanics of thin film multilayers

Dual cure (photopolymerization and sol-gel condensation) ternary phase diagram



1) Nacre
2) Diatom
3) Bone
4) Ophthalmic lenses *(multilayer hybrid coatings)*
5) Dental restoration *(silica nanocomposites)*
6) Cancer treatment *(core-shell nanoparticles)*
7) Solar cells (*diffusion barrier layers*)
8) Tires *(clay and silica nanocomposites)*

Selected references

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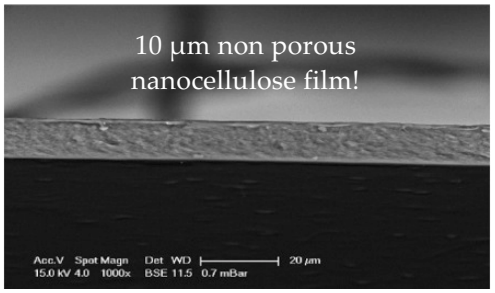
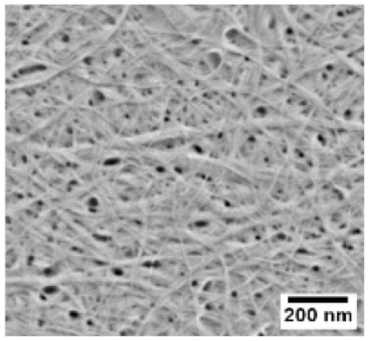
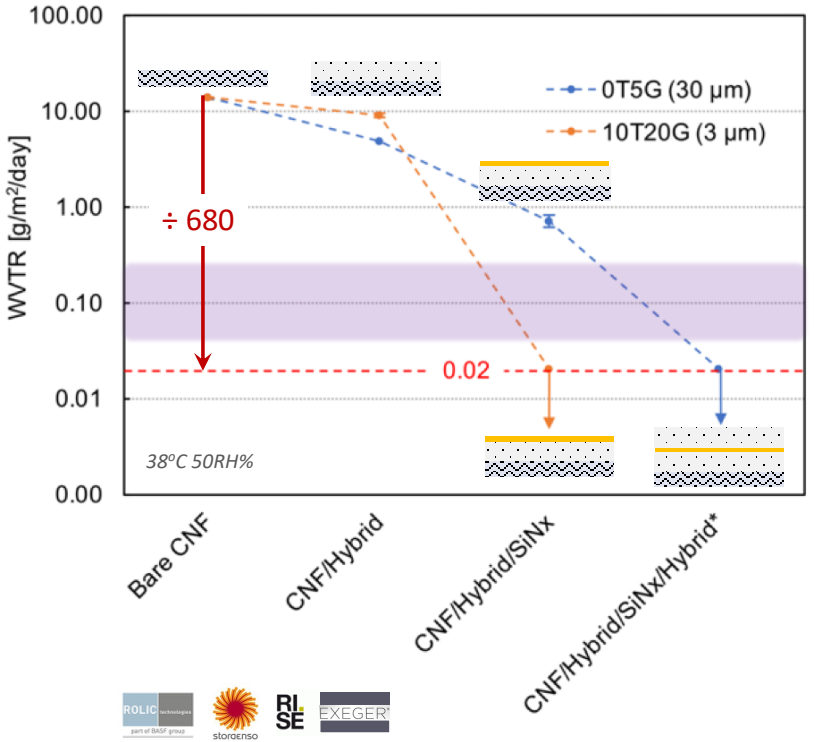
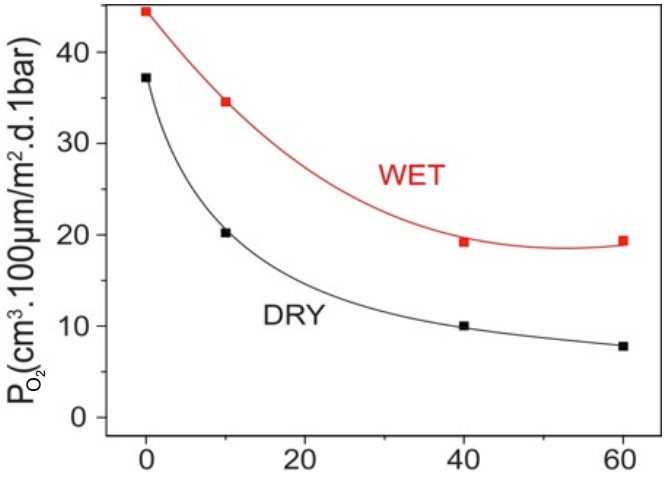
Ultra high barriers based on UV cured organic-inorganic hybrids and cellulose nanofibrils substrates







Oxygen permeability of UV-cured transparent nanocellulose-acrylate composites



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Bioinspired surfaces

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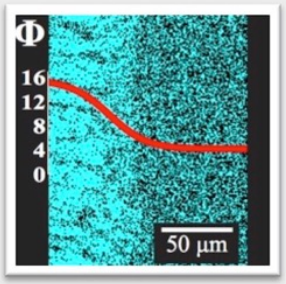
Self-cleaning
Superhydrophobic plants

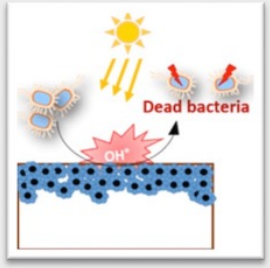
Light-scattering
Snow white

Antireflective
Moth-eye

Functionally graded
Superhard, graded dielectrics



Antibacterial

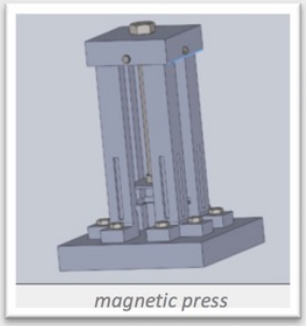


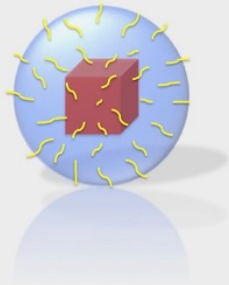
UVNIL (batch and R2R)
Dual-cure (UV + sol-gel)

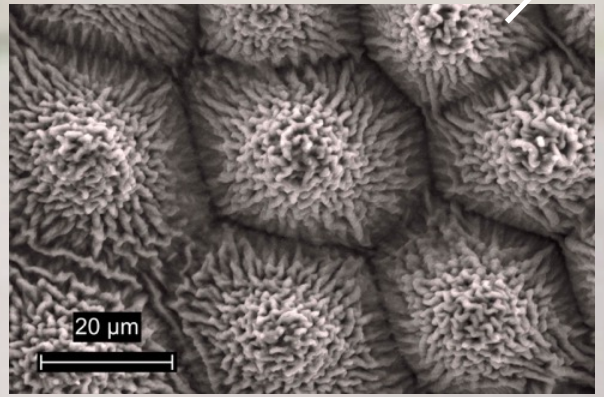
Photo-hyphenated methods

Photo-rheology
Photo-calorimetry
Photo-interferometry
Photo-stress

Magnetophorese + core-shell magnetic nanoparticles







materials

MDPI

Article

A Facile *in Situ* and UV Printing Process for Bioinspired Self-Cleaning Surfaces

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Abstract: A facile *in situ* and UV printing process was demonstrated to create self-cleaning synthetic replica of natural petals and leaves. The process relied on the spontaneous migration of a fluorinated acrylate surfactant (PFUA) within a low-shrinkage acrylated hyperbranched polymer (HBP) and its chemical immobilization at the polymer-air interface. Dilute concentrations of 1 wt. % PFUA saturated


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