

# Macromolecular Chemistry & Responsive Polymers

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## Main expertise fields

- New approaches for the synthesis of advanced thermoplastics, thermosets and elastomers with targeted properties
- Chemistry, physics and transport behaviour of charged (macromolecular systems such as ionic liquids and polyelectrolytes)
- Physics, structure and dynamics of polymers and nanocomposites, and associated multiscale modelling and strometric simulations
- Elastic and inelastic x-ray and neutron scattering techniques
- Contact mechanics, adhesion, friction, and surface interactions
- Mechanics of fracture, failure and fatigue of polymeric materials
- Additive manufacturing, 3D/4D printing and polymer processing

## Research challenges

- Creation of advanced organic materials for actuators, energy storage, sorption, transport and sensing applications
- Application of advanced polymer chemistry and engineering approaches to generate high performance polymers and elastomers
- Development of novel computational approaches to better describe single and multiphase polymer melts and solutions and their interactions with nanoparticles
- Understanding, prediction and design of nanocomposite structure, viscoelastic, mechanical and tribological performance and transport behaviour
- Utilization of printing and additive manufacturing as a means of processing novel high performance macromolecular materials

## Application areas

- Additive manufacturing
- Electrochemical energy storage
- Gas sorption and gas separation
- High-performance polymeric materials
- Sensing, actuation and energy generation
- Tire compound and reinforcement engineering

## Main assets

1. [DISAFECAL](#) (ongoing)
  - Novel polyelectrolytes for energy storage
- Goodyear-LIST partnership (ongoing)
  - Synthesis of high performance polymeric materials for tires
- [VISCOMANO](#) (ongoing)
  - Physics of ionic polymer nanocomposites
- [COATHIN](#)
  - Liquid-assisted Nanopulsed Plasma Deposition of Multifunctional Coatings with Interpenetrating Hydrogel Networks
- InterBATT
  - Next generation all-solid-state Li-Sulfur Battery
- Other assets (academic & industrial)

## Equipment

- [High-Performance Computing](#)
- Specific glassware for moisture and air sensitive chemistry
- Schlenk lines
- High pressure glass reactors with working temperatures from -20 to +200°C
- Glassware for monomers and polymers synthesis
- Argon glove box
- Anhydrous solvents circulation apparatus
- Vacuum ovens and bells
- Bunch glass drying apparatus (allow to dry samples and transfer them directly into the glove box without contact with atmosphere)
- Milli-Q water purification system
- 1200 Infinity gel permeation chromatograph with an integrated RI detector
- 1260 Infinity H gel permeation chromatographs with triple detectors (RI, Visc and Light Scattering)
- Viscometers with various capillary diameters and thermostat
- Mobile VSP potentiostat/galvanostat
- Coin cell 2032 battery press
- Automatic film applicator
- Freeze-dryer for organic solvents

## Selected publications

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- Gouveia, A. S. L.; Makrakis, E.; Loznitskaya, E. I.; Shaplov, A. S.; Tomé, L. C.; Marmcho, J. M. [Poly\(ionic Liquid\)/Ionic Liquid Membranes with Transversal Oriented Anions: Characterization and Biophysics Separation](#). *ACS Sustainable Chem. Eng.* 2020, 8 (18), 7087-7096.
- Khan, M. S.; Karantratos, A. V.; Ohta, T.; Cai, Q. [The Effect of Infrared Organic Solvents and Anions Salts on Sodium Ion Storage in Cylindrical Carbon Nanotubes](#). *Phys. Chem. Chem. Phys.* 2019, 21 (41), 22732-22731.
- Karantratos, A.; Composto, R. J.; Winney, K. I.; Kröger, M.; Clarke, N. [Isolation of Extended Polymer Diffusion in Melts and Nanocomposites: A Review](#). *Polymers* 2019, 11 (5), 876.
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## Partenaires

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