

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
- Polymer, physical and computational modeling of macromolecular systems such as ionic liquids and polyelectrolytes
- Physics, mechanics and dynamics of polymers and nanocomposites, and associated multiscale modelling and atomistic 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
- Sensing, actuation and transportation
- High-performance polymeric materials
- Sensing, actuation and energy generation
- Tire compound and reinforcement engineering

Main assets

- 1. **DISAFCAP** (ongoing)

- Novel polyelectrolytes for energy storage

- Goodyear-LIST partnership (ongoing)

- Synthesis of high performance polymeric materials for tires

- **VISIONNANO** (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

- **Electron Microscopy**
- 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
- Anhydrous solvents circulation apparatus
- Vacuum ovens and belts
- Buchli glass drying apparatus (allow to dry samples and transfer them directly into the glove box without contact with atmosphere)
- Gel permeation chromatography system
- 1200 Infinity gel permeation chromatograph with an integrated RI detector
- 1260 Infinity II gel permeation chromatographs with triple detectors (RI, Viscos and Light Scattering)
- Mobile VSP potentiostat/galvanostat
- Coin cell 2023 battery press
- Freeze dryer for organic solvents

Selected publications

- Sharov, A. S.; Merello, R.; Mecerreyes, D. **Recent Advances in Innovative Polymer Electrolytes Based on Polymeric Liquids**. *Electrochimica Acta* 2015, 175, 18-34.
- Ponskrab, O.; L. Shapiro, A. S.; Vlachouli, C.; Vlachouli, I.; Sharov, A. S.; Gerasimov, D.; Germain, C. **Single-Ion Block Copolymeric Liquids as Electrolytes for All-Solid-State Lithium Batteries**. *ACS Appl. Mater. Interfaces* 2016, 8 (14), 10350-10359.
- Ponskrab, O.; L. Shapiro, A. S.; Vlachouli, C.; Vlachouli, I.; Sharov, A. S.; Gerasimov, D.; Germain, C. **Single-Ion Block Copolymeric Liquids as Electrolytes for All-Solid-State Lithium Batteries**. *Journal of Power Sources* 2017, 364, 191-199.
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- Ponskrab, O.; L. Shapiro, A. S.; Vlachouli, C.; Vlachouli, I.; Sharov, A. S.; Gerasimov, D.; Germain, C. **Synthesis of Novel Families of Conductive Catenolic Polymeric Liquids and Their Application in All-Polymer Flexible Pseudo-Supercapacitors**. *Electrochimica Acta* 2018, 281, 777-788.
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- Sharov, A. S.; Li, M.; Micallef, J.; L. Shapiro, A. S.; Tomé, L. C.; Marrucho, I. M. **Polymer-Liquid Ionic-Liquid Membranes with High Ion Conductivity and Selectivity for Separation and Redox Reactions**. *ACS Sustainable Chem. Eng.* 2020, 8 (18), 7087-7096.
- Karantatos, A.; Composto, R. J.; Sharov, A. S.; Tomé, L. C. **Impact of Ionic Liquids on Cation Transport in Cylindrical Electrodes**. *Phys. Chem. Chem. Phys.* 2019, 21 (41), 22722-22731.
- Karantatos, A.; Composto, R. J.; Sharov, A. S.; Tomé, L. C. **Impact of Ionic Liquids on Cation Transport in Cylindrical Electrodes**. *Phys. Chem. Chem. Phys.* 2019, 21 (41), 22722-22731.
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- Ivanenko, I.; Tschekhovskov, V.; Saphanikova, M.; Stoyanov, K. W.; Petry, F.; Hennig, G. **Modeling of Dynamic-Mechanical Behavior of Reinforced Elastomers**. *Polymer* 2014, 82, 356-365.
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Partenaires

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