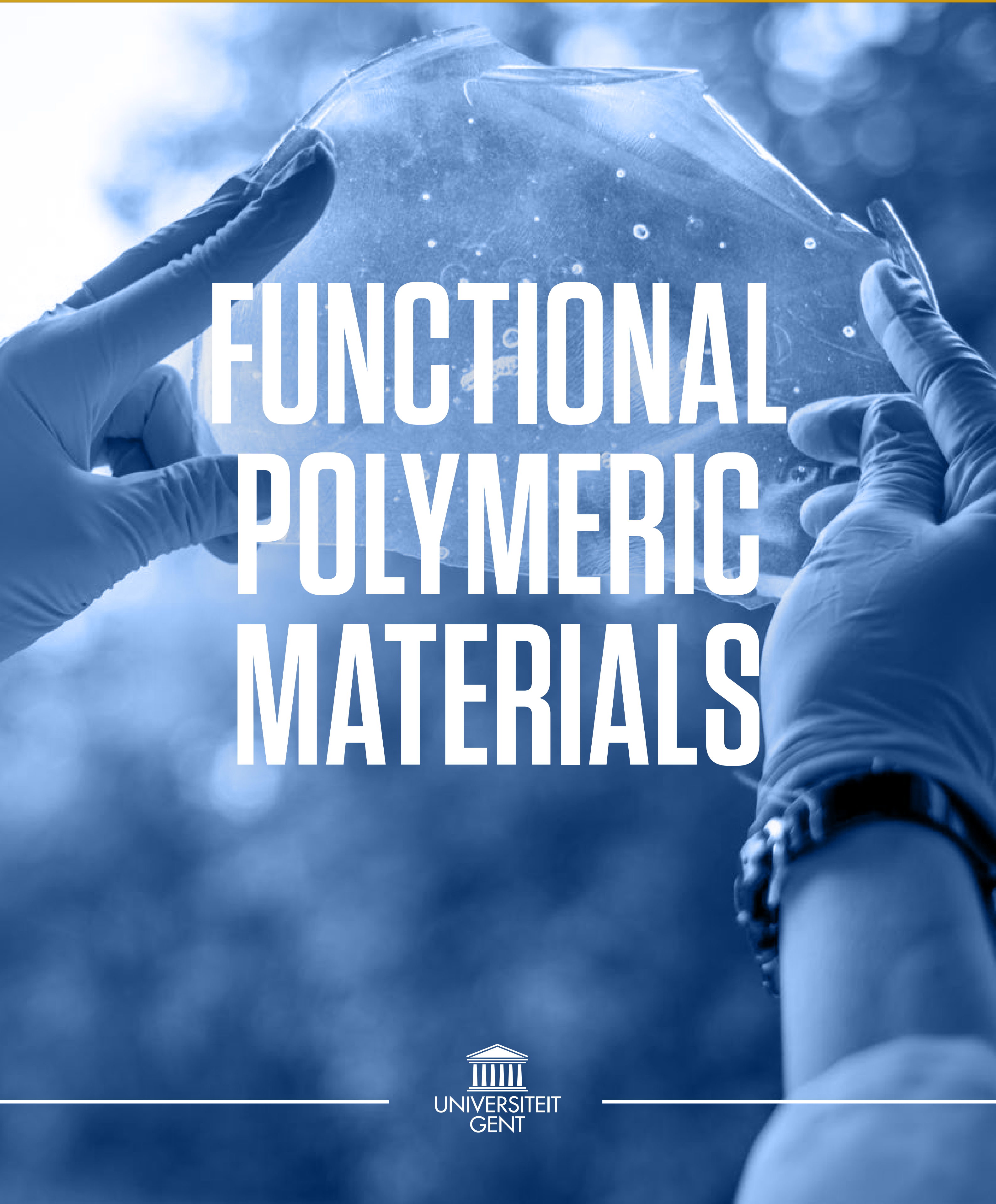
EXPERTISE AT UGENT



FUNCTIONAL POLYMERIC MATERIALS

UNIVERSITEIT GENT

OUR OFFER

APPLICATION DRIVEN POLYMER SYNTHESIS AND DESIGN

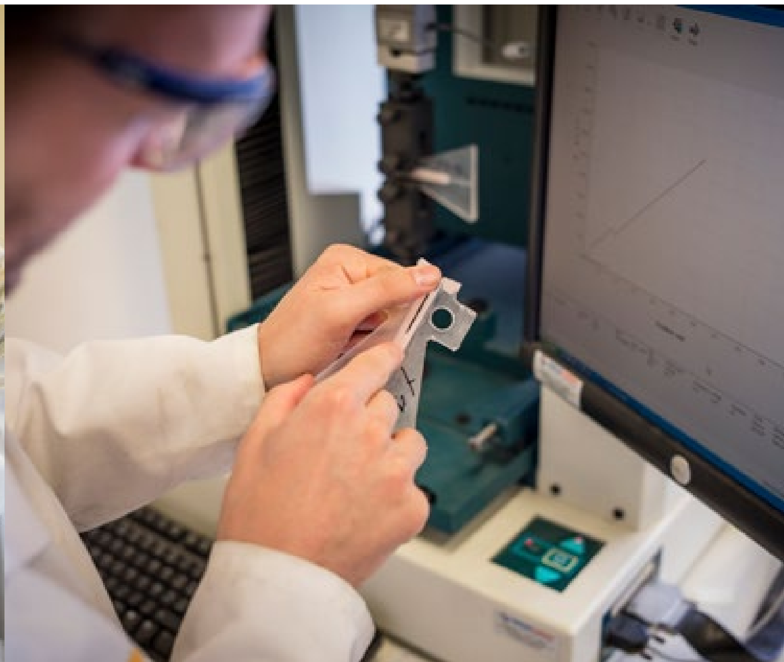
THROUGH DEEP UNDERSTANDING OF ADVANCED MACROMOLECULAR CHEMISTRY

At UGent we focus on the synthesis, characterization and application of functional polymer structures and polymer-derived materials. We are able to control nanostructure, morphology and self-assembly in solution, solid state and thin films. In addition, our researchers have a strong expertise in a diverse set of application domains.

With our highly interdisciplinary approach, we develop novel and more efficient synthetic strategies for the preparation of polymer materials by a combination of fine control over the polymer chemistry and an in-depth characterization of the materials generated. Important examples of our research activities include:

- Development of novel polymeric dispersants, surfactants and compatibizers
- Self-healing solutions for coatings and composites
- Novel approaches for microencapsulating reactive molecules
- Integrating bio-based building blocks targeting high-end niche applications
- Dynamic polymeric systems (e.g. vitrimers and supramolecular polymers) for coatings and composites
- Novel scalable click chemistry for polymer functionalization and design
- Development of stimuli-responsive hydrogels (e.g. thermo-, pH-, electro- and molecule-responsive materials)
- Design and preparation of micro- and nanoparticles and carriers (e.g. controlled delivery systems)
- Polymers as novel drug excipients (e.g. for formulation of drugs in solid dispersions)
- Novel polymeric conjugates for targeted drug delivery and/or with enhanced blood half-life
- Functionalization of (bio)polymers to enhance or to prevent cell interactions (e.g. for biocompatible coatings)
- Development of biosensors and polymers for biophotonic applications
- Advanced polymeric 3D-scaffolds for tissue engineering (e.g. bone or liver regeneration)
- High-end (bio)polymer processing through 3D printing (e.g. fused deposition modelling), (co-extrusion) electro-spinning, inkjet printing, two-photon polymerization and combinations thereof for scaffold and fiber production

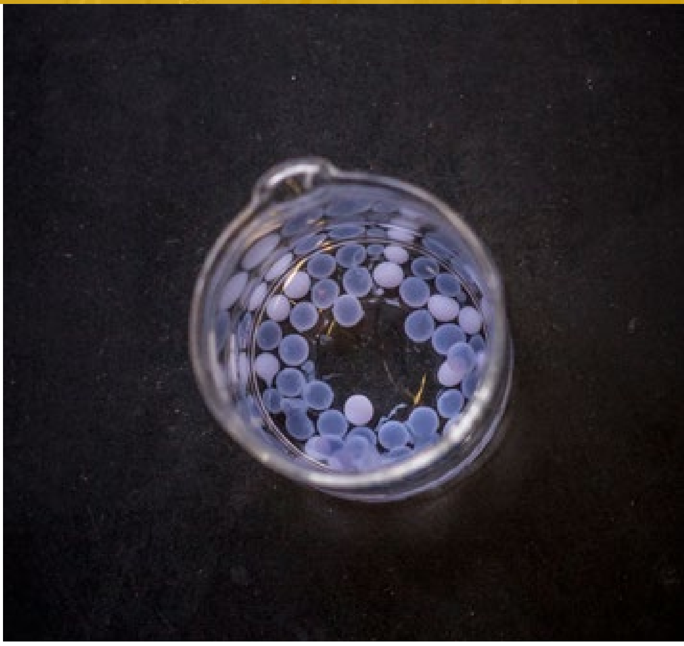
The above is a non-exhaustive list of examples of the materials and corresponding applications that can be targeted with our defined polymer structures. We develop tailor-made polymer solutions for a diverse set of industries: e.g. chemical & material industries, household & personal care, pharmaceutical & biotech industries, biomaterial companies or medical device industries.



OUR OFFER

- NOVEL MONOMERS AND (PRE)POLYMERS
- ADVANCED METHODOLOGIES FOR POLYMER SYNTHESIS
- FUNCTIONALISED POLYMERS AND POLYMER ARCHITECTURES
- POLYMER COATINGS AND SURFACE MODIFICATIONS
- RESPONSIVE POLYMERIC MATERIALS
- HYDROGELS AND CARRIERS
- NANO/MICRO-PARTICLES AND FIBERS
- SOFT AND RIGID POLYMERIC 3D-SCAFFOLDS

OUR TOOLBOX

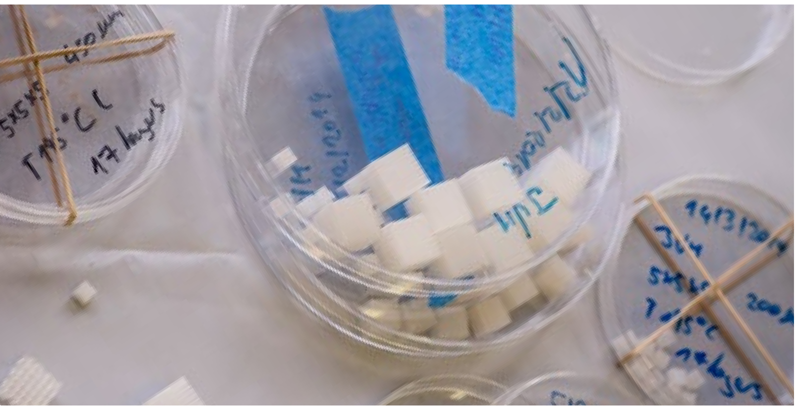


CHEMICAL TOOLBOX

Organic Synthesis Our teams have expertise in synthesizing novel monomers and initiators as well as in the chemical modification of available building blocks. We offer extensive organic synthesis and characterization facilities.

Polymer Synthesis We are specialized in the preparation of well-defined polymers with narrow molar mass distribution and good end group fidelity by **living cationic ring-opening polymerization** and **controlled radical polymerization** (RAFT, ATRP, NMP and Cu(0)-mediated polymerization)**.** Also, several types of polycondensations are used in a wide number of ongoing projects. To derive structure-property correlations in polymeric materials, we synthesize libraries of (co)polymers via high-throughput polymer synthesis in order to predict and control the desired polymer properties. Both parallel conventionally heated and serial microwave heated synthesis robots are available as well as a range of high-throughput analytical techniques to optimize polymerization kinetics and to determine polymer properties. These advanced synthesis tools also allow the development and optimization of fast and green synthetic protocols.

Polymer Functionalization We functionalize polymers during polymerization as well as by post-polymerization modification, often by making use of 'click' chemistry platforms, as a function of the targeted applications. In addition, we have acquired expertise in the functionalization of synthetic polymers and biopolymers with crosslinkable moieties and/or low molecular weight compounds (e.g. peptides, aptamers, labels and drugs) depending on the envisaged application.



CHARACTERIZATION TOOLBOX

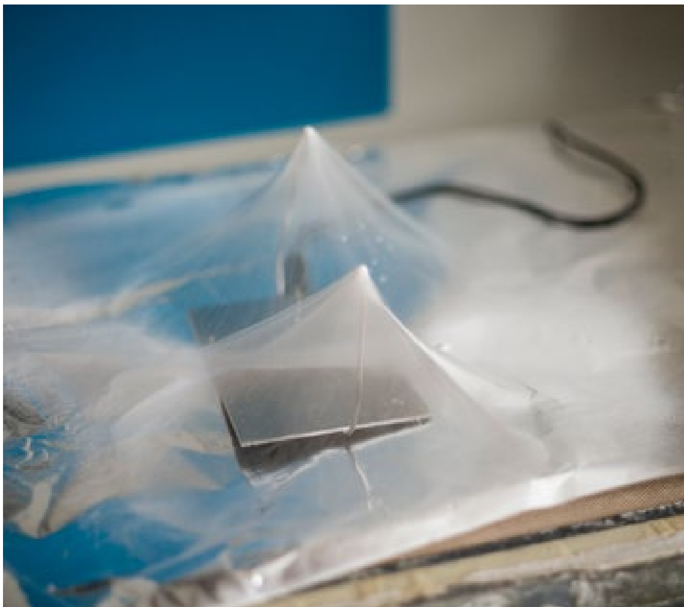
Our researchers have following advanced characterization infrastructure at their disposal:

- **Molecular characterization:** Structural elucidation using NMR, MALDI-TOF, on-line IR, ...
- **Polymer structure characterization:** Determination of molecular weights and molecular weight distributions by size-exclusion chromatography (range of eluents and detectors) and 2D LC/SEC. Characterization of crosslinked (hydrogel) networks using HR-MAS NMR and dynamic and static vapor sorption measurements, ...
- **Polymer Solution behavior** by turbidimetry, dynamic light scattering, particle size measurements, viscosimetry,...
- **Surface visualization and characterization:** Measurement of microscopic features and microstructures to nano-scale dimensions using optical microscopy, SEM, TEM, AFM, IR mapping, XRD, XPS, ... Surface wettability using static and dynamic contact angle measurements. Surface interactions through quartz crystal microbalance-coupled ellipsometry.
- **Thermal and mechanical analysis:** Thermal behavior can be studied with differential scanning calorimetry and thermogravimetry; the mechanical behavior by dynamic mechanical analysis, rheology and materials testing equipment.

ADVANCED PROCESSING TOOLBOX

(Co-extrusion) electrospinning We offer our expertise and knowhow to assist you from the material selection till the pilot scale. After careful selection of the materials (including the solvent system), fibers are electrospun using mono- and multinozzle lab equipment. In addition, core-shell fibers can be produced using our co-extrusion electrospinning setup. Depending on the application, subsequent functionalization of the electrospun fabric will be necessary. Finally, our pilot installation can be used to produce the desired quantities for application testing.

3D-printing In addition to thermoplasts (e.g. PET, PCL, PLA), we process hydrogels building blocks (natural versus synthetic polymers) and cell suspensions using the Bioplotter technology through a CAD-CAM approach. We also offer solutions for in situ curing of crosslinkable polymer precursors. We also have at our disposal fused deposition modelling to process polymer filaments (PLA and PCL) into predetermined shapes. The 3D-printed architectures can be surface-functionalized (e.g. cell-interactive, hydrophilic) if required depending on the envisaged application. Finally, we offer combinations of inkjet printing together with tunable polymer technology for optical (e.g. waveguides) and biomedical applications.



OUR EXPERT TEAM

PROF. FILIP DU PREZ
Polymer Chemistry Research Group (PCR)

PROF. RICHARD HOOGENBOOM
Supramolecular Chemistry Group (SC)

PROF. PETER DUBRUEL
Polymer Chemistry and Biomaterials Group (PBM)

PROF. SANDRA VAN VLIERBERGHE
Polymer Chemistry and Biomaterials Group (PBM)

The key objectives of the **Polymer Chemistry Research Group** (PCR) can be described under the general heading "design, characterization and application of tailor-made, functional polymer structures and polymeric-derived materials".

Three main research themes can be distinguished:
– From polymer functionalization to absolute control
– Dynamic and self-healing polymeric materials
– Giving renewable polymers function(ality)

With our highly interdisciplinary approach, we are targeting novel, often industrially applicable polymer materials, for use in such areas as self-healing polymers, sustainable coatings, vitrimers, informatics, polymeric dispersants, packaging, particle design, recycling and reshaping.

The research of the **Polymer Chemistry & Biomaterials Group** (PBM) can be subdivided in the following research activities:
– Functional polymers for biomedical applications
– Biomaterials: e.g. biocompatible coatings
– Advanced drug/gene delivery systems
– Scaffolds for tissue engineering
– Biosensors and polymers for biophotonic applications

Polymer synthesis facilities are available to perform various types of polymerizations and characterization of polymer bulk properties. In addition, state-of-the-art equipment is available for surface modification & characterization. Furthermore, rapid prototyping (Bioscaffolder, fused deposition modelling), inkjet printing and a (co-extrusion) electrospinning device are available for polymer processing.

The research of the **Supramolecular Chemistry Group** is inspired by the beauty of natural self-assembly processes. Nature exploits a limited number of building blocks in combination with non-covalent and hydrophobic interactions to build complex functional assemblies, such as proteins and cells. The research of this group aims to develop well-defined synthetic structures with controlled ordering and/or self-assembly resulting in functional systems. The use of synthetic building blocks allows a higher level of complexity when compared to the limited diversity in Nature. Moreover, the combination of well-defined 'smart' polymer structures with supramolecular interactions provides an ideal platform to develop functional systems for, e.g., sensors and diagnostics, drug delivery and responsive hydrogels. The research of the group can be subdivided in three main research directions:
– Supramolecular polymers
– 'Smart' responsive polymer structures
– Poly(2-oxazoline)s as pseudo-polypeptides

Application areas that are targeted include polymer therapeutics, diagnostics, drug delivery, biomedical devices, cosmetics, and personal care.

Our polymer expert team from the three involved research groups (PCR, PBM and SC) jointly founded the Centre of Macromolecular Chemistry, shortly 'CMaC'
www.CMaC.ugent.be

CONTACT INFORMATION

The Functional Polymeric Materials cluster is supported by
the business unit **ChemTech**, that is the focal point
for **industrial collaborations** between research groups
dealing with chemistry and companies
that are looking for chemical expertise.

ChemTech facilitates and coordinates a set of **industrial projects**
and manages a **strategic IP portfolio** and its licensing opportunities.

The business developers of ChemTech are at your disposal:

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