PSEP

Synthetic Polymers: Structure and Properties. Biodegradable Polymers

Specific services:

- Synthesis of synthetic polymers.
- Analysis and identification.
- Determination of molecular weights.
- Structural characterization.
- Morphological studies.
- Study of multiphase and nanoconfined systems.
- Study of crystallization kinetics.
- Evaluation of mechanical properties.
- Study of hybrid systems.
- Degradation studies.

- Synthesis of new polymers
- Characterization and properties
- Study of the crystalline structure
- Preparation of nanocomposites

The research is performed in the framework of different projects funded by MCINN/FEDER and AGAUR as well as by agreements with private companies.

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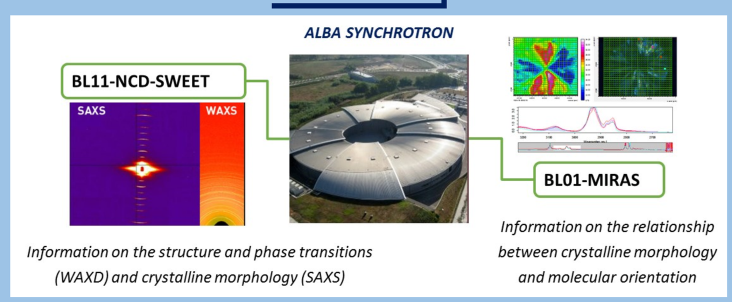


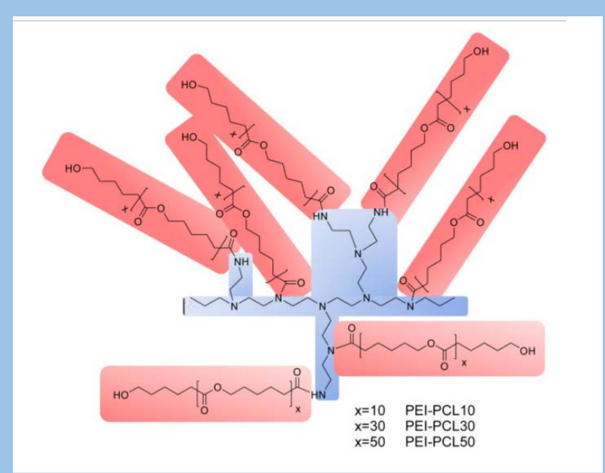
IBEC

Barcelona **Research Center in Multiscale Science** and Engineering

The Group is opened to research collaborations in the different topics here showed

Synthesis of degradable polymers

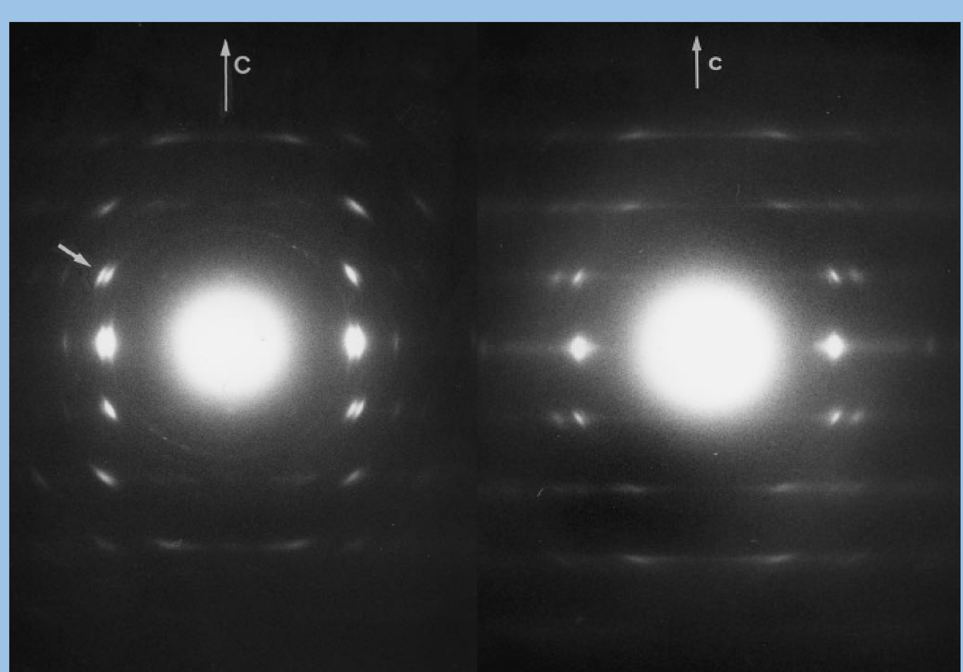
Capacity to synthesize polyesters, poly(ester amide)s, poly(ester urea)s and copolymers with alternate, random and block distributions. Architecture variable: linear, hyperbranched and multi-arm star. Preparation of functionalized and crosslinked polymers. Solution, interfacial, melt and solid polymerizations.



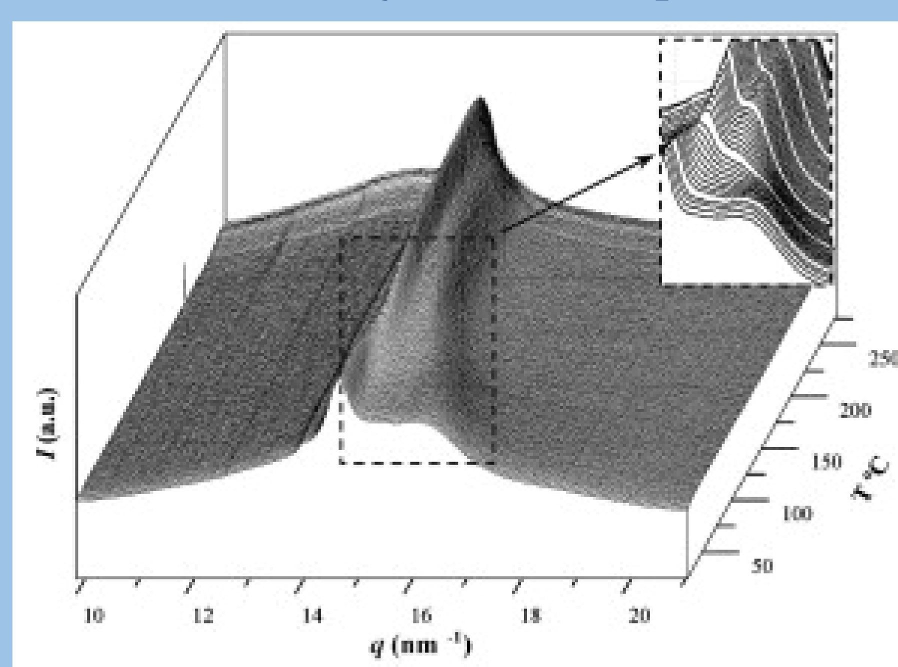
Crystalline structure

Resolution of the crystalline structure of polymers by means of fiber X-ray diffraction, electron diffraction of crystalline lamellae and X-ray diffraction of single crystals of model compounds. Study of temperature-induced crystal transitions (synchrotron radiation).

Electron diffraction patterns



Real-time X-ray diffraction profiles

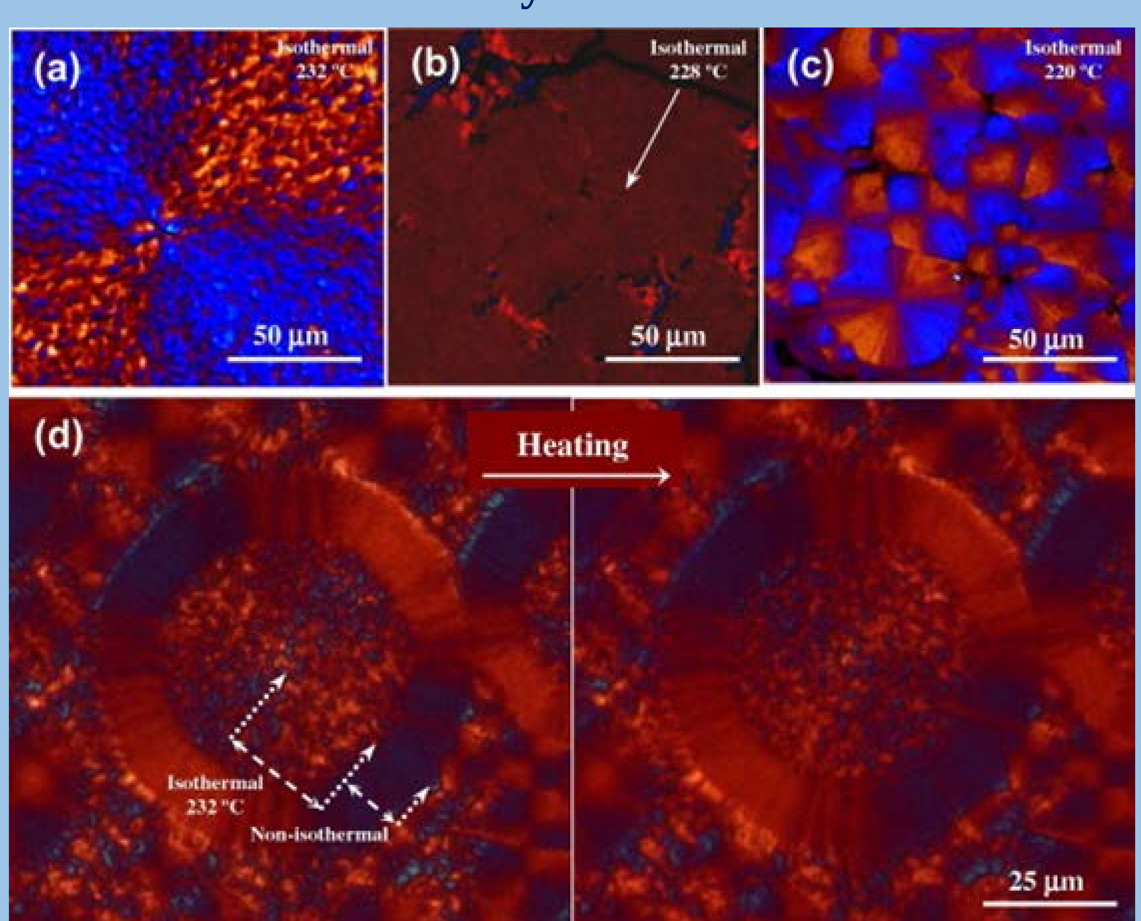


Electron diffraction patterns of epitaxially grown samples showing different crystalline forms of polylactide (left). Temperature evolution of the X-Ray diffraction profiles showing two crystalline phase transitions on nylon 69 (right).

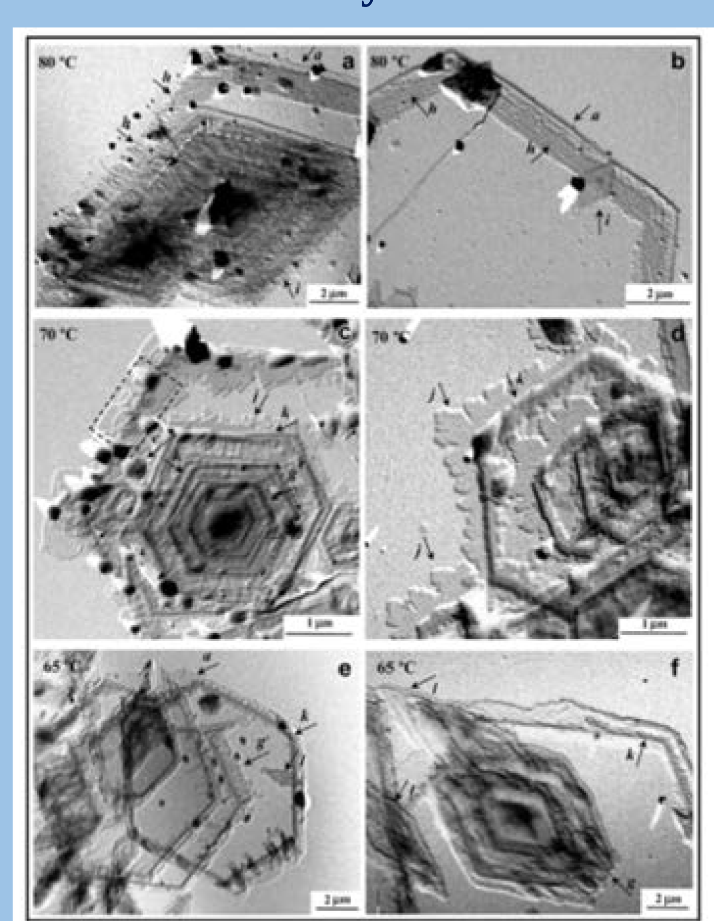
Crystallization processes

Study of isothermal and non-isothermal crystallization by means of calorimetry (DSC), optical microscopy (OM), spectroscopy and synchrotron radiation.
Study of crystalline morphologies by optical microscopy, transmission electronic microscopy (TEM) and atomic force microscopy (AFM).

Melt crystallization



Solution crystallization



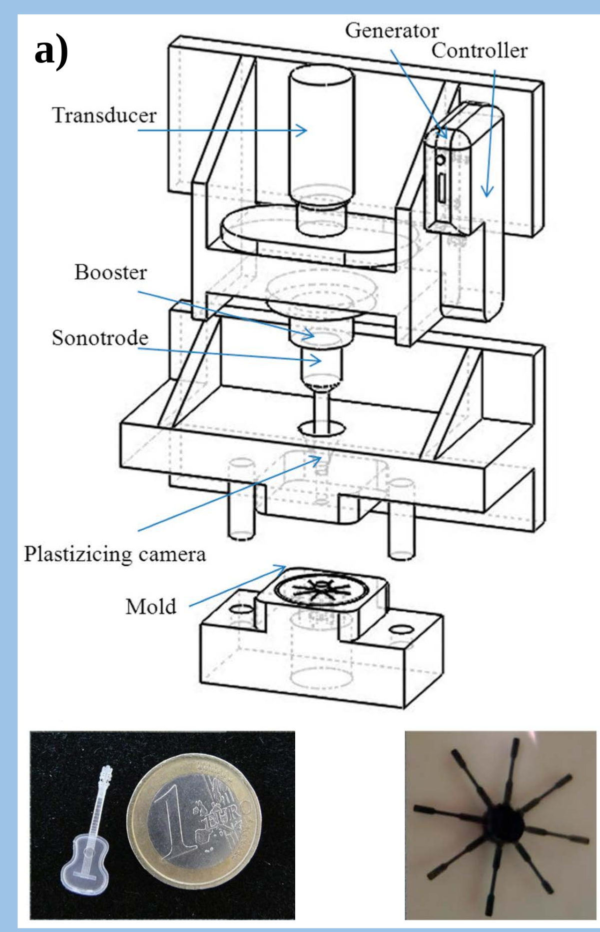
Spherulitic morphologies of nylon 47 (polarized MO) having an unusual temperature reversible behavior on the birefringence (left). Lamellar crystals (TEM) obtained at different temperatures of a block copolymer constituted by lactide and caprolactone units (right).

Polymer processing

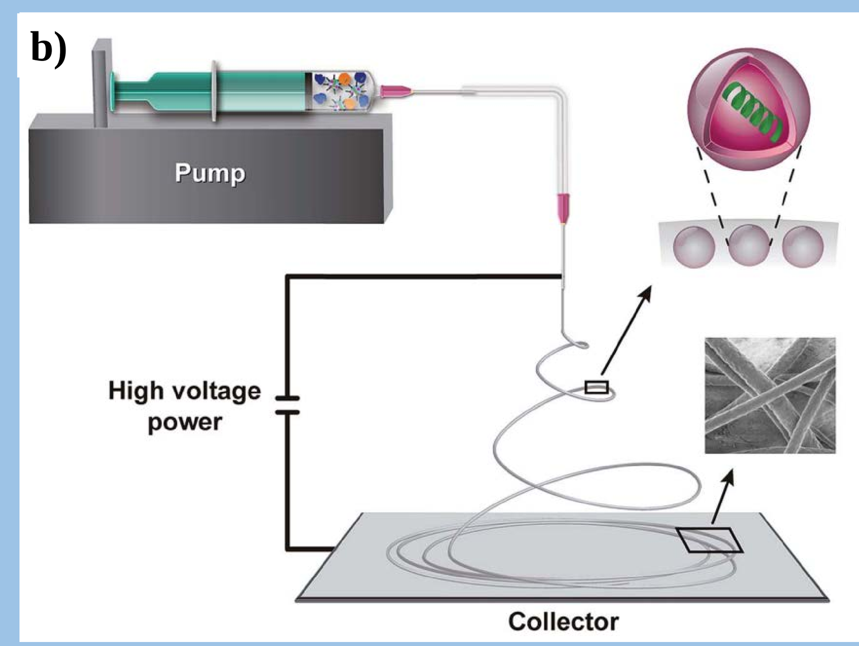
Development of new processing technologies based on the use of ultrasound energy source. Micromolded specimens with a high detailed precision and minimum loss of material can be obtained in very short times (2-6 seconds).

Preparation of scaffolds for tissue regeneration by solution and melt electrospinning.

Ultrasound micromolding



Microemulsion electrospinning set up



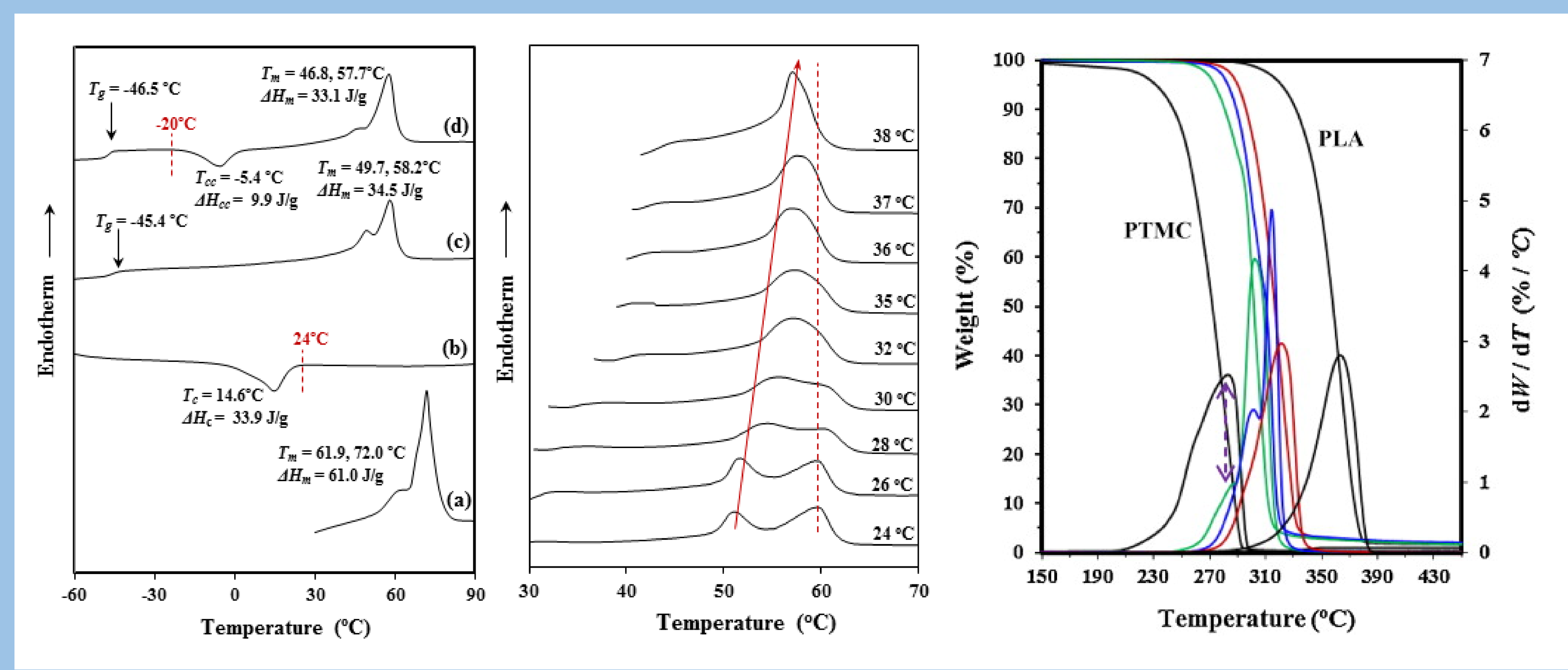
Ultrasound micromolding equipment and typical processed specimens. The high precision of the technique is demonstrated because the strings of the guitar can be appreciated (a). Schematic arrangement of laboratory electrospinning equipment (right). Horizontal, vertical and single coaxial set ups can be easily selected.

Thermal properties

Thermal characterization and thermal stability of new polymer, blends, nanocomposites and drug-loaded samples.

DSC curves

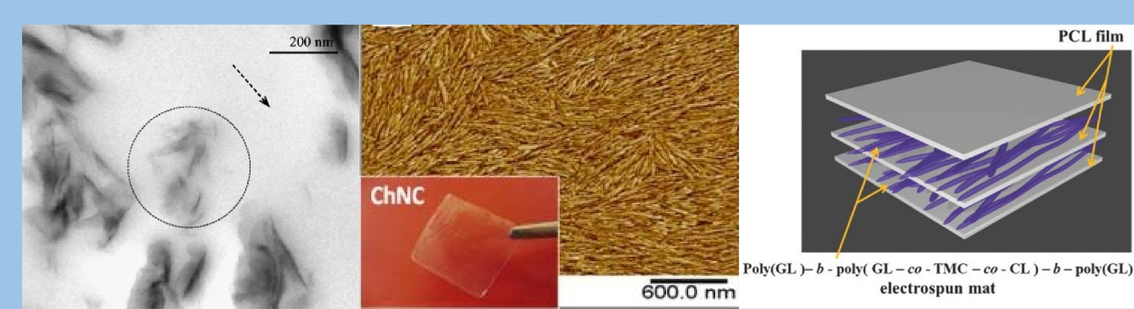
TGA/DTGA curves



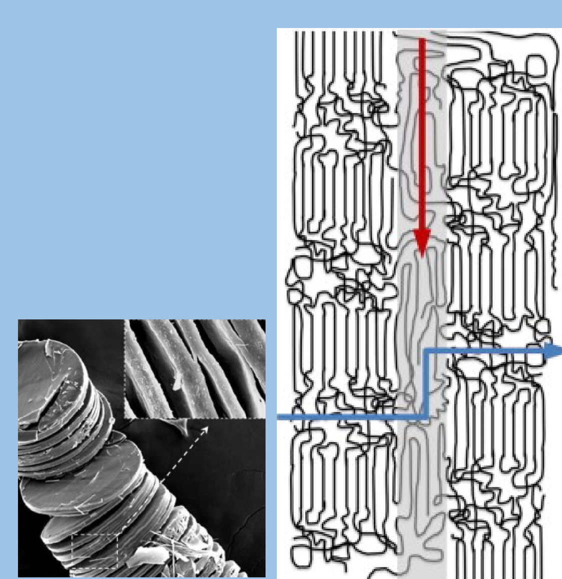
Samples are studied with different DSC runs to evaluate the behavior on melting and crystallization (from the glass and the melt state). Great differences can be seen in a sample of Poly(4-hydroxybutirate) (P4HB) commercial suture depending on the thermal treatment (left). Processing temperature can lead to different morphologies as evidenced in the melting curves (medium). Comparison of thermal stability of polylactide (PLA) and Poly(trimethylene carbonate) (PTMC) homopolymers and their mixtures. An anomalous behavior is observed on the physical blends (right).

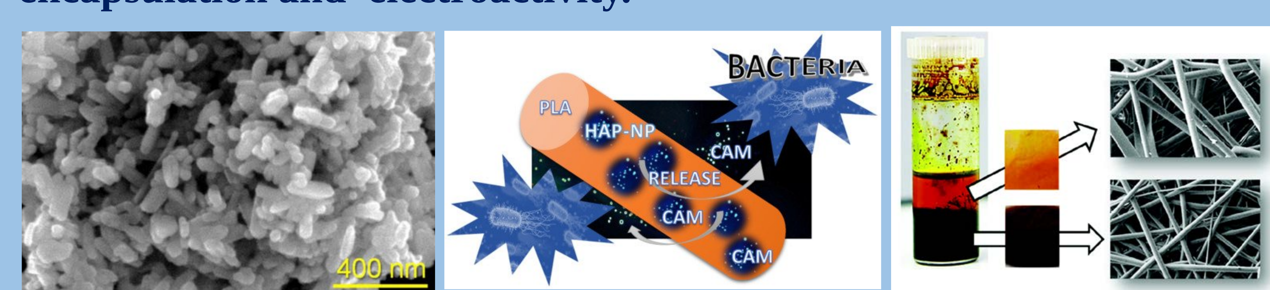
Applied research

Development of nanocomposites based on nanoclays, chitin or other natural polymers. Fabrication of multilayered nanoconstructs with improved mechanical properties and selective drug release.



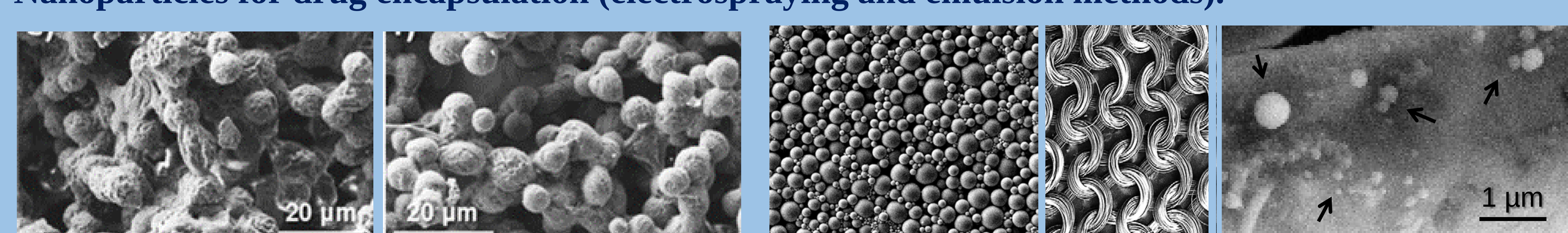
Applications of hybrid systems based on hydroxyapatite/synthetic polymer and degradable/conducting polymers for drug encapsulation and electroactivity.



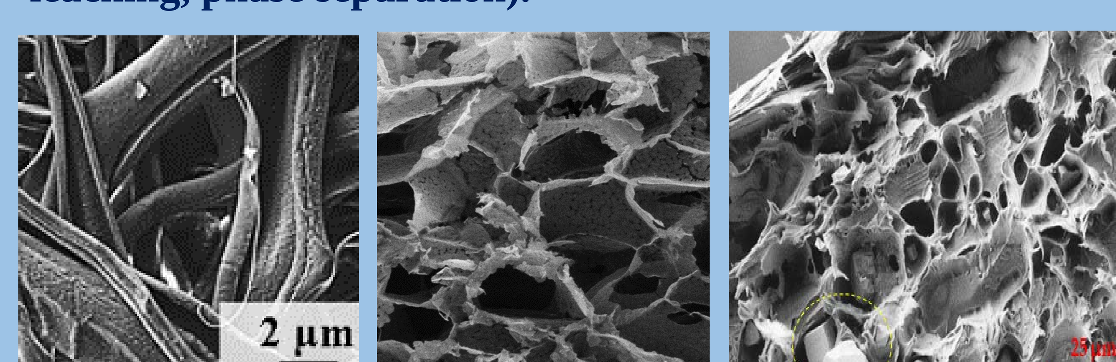


Bioresorbable surgical sutures.

Nanoparticles for drug encapsulation (electrospraying and emulsion methods).



Scaffolds for tissue regeneration (electrospinning, salt leaching, phase separation).



Materials with bactericide, wound healing, antitumoral properties.

Development of new hydrogels.