Innovation in Materials and Molecular Engineering (IMEM)

IMEM group uses transformative chemical engineering and computer modelling approaches to overcome severe limitations in current materials used in wide range of scientific areas. The group works in:

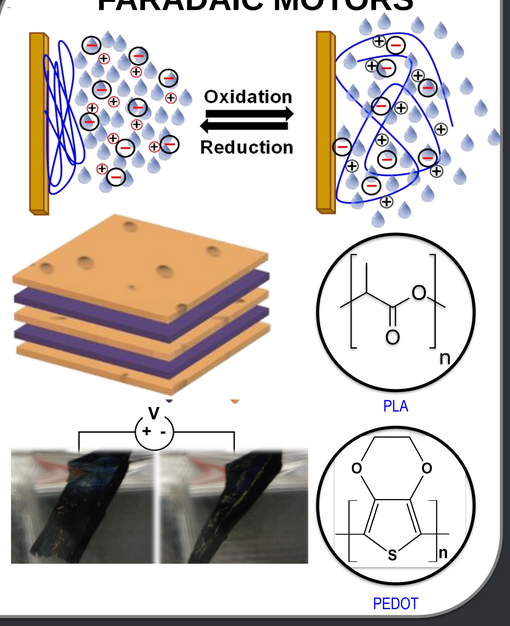
- Generation of new electronic devices for biosensing, drug delivery and energy storage,
- Development of corrosion studies for daily life objects that suffer from the environment conditions
- Computer simulations for biomedical applications.

The IMEM group uses highly multidisciplinary approaches and comprises bioengineers, material scientists, chemists, and biologists.

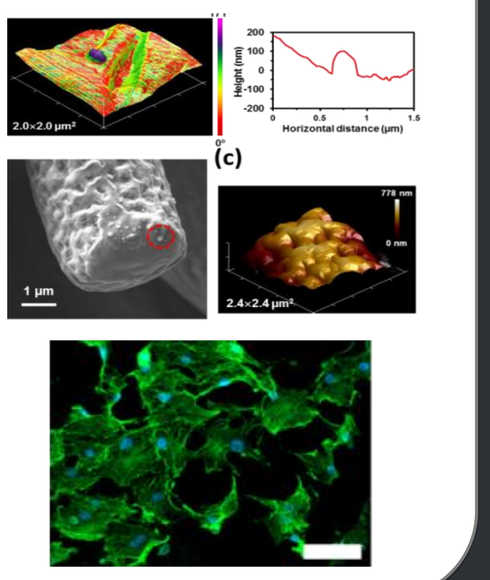
ELECTRONIC DEVICES

- Nanosystems based on conducting polymers.
- Submicro- and nanometric multilayered systems formed by alternated layers of two or more conducting polymers.
- Nanometric structures formed by conducting polymers and clays: synthesis, characterization and applications.
- Electroactive nanosensors for the detection of specific molecules.
- Controlled drug delivery systems.

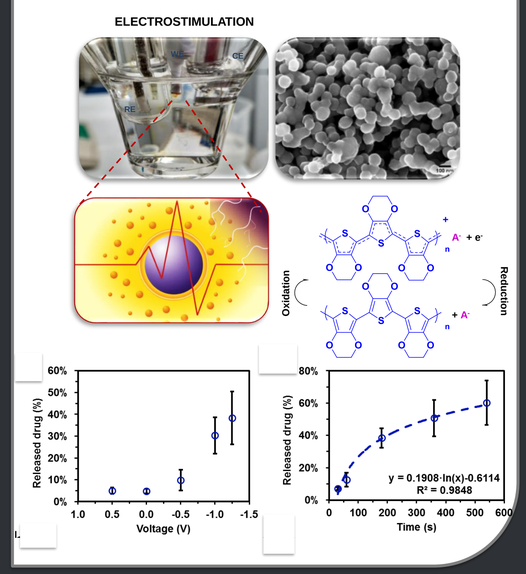
FARADAIC MOTORS



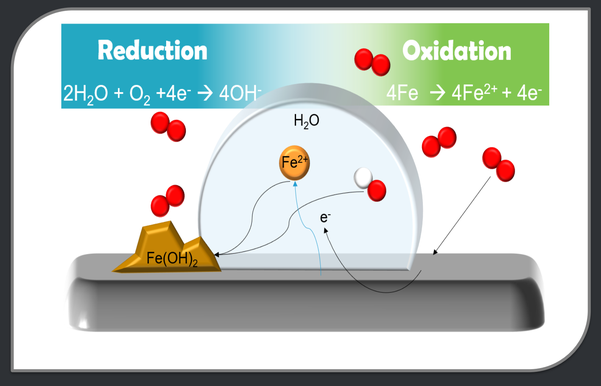
CELLULAR SCAFFOLDS



DRUG DELIVERY SYSTEMS

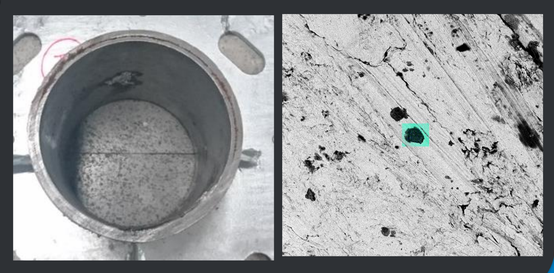


CORROSION STUDIES



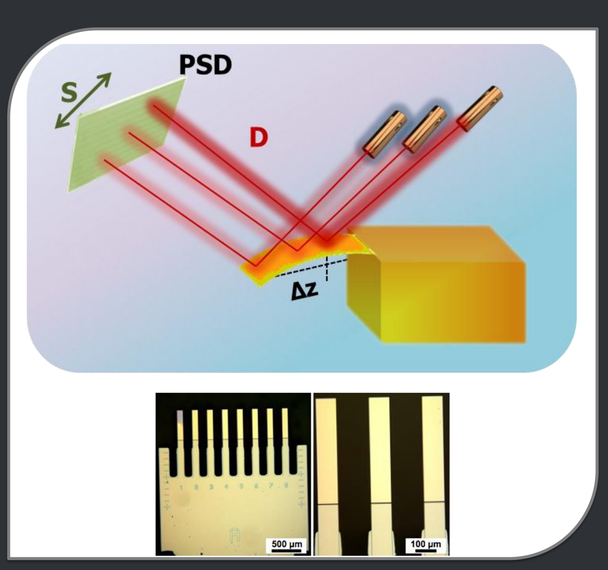
Corrosion represents over the 3.5% of the gross world product. Therefore, many efforts have been deposited on the design and synthesis of new methodologies and materials to prevent it.

The study of the corrosion is carried out by measuring the material thickness, the chemical composition, and the polarization curves.

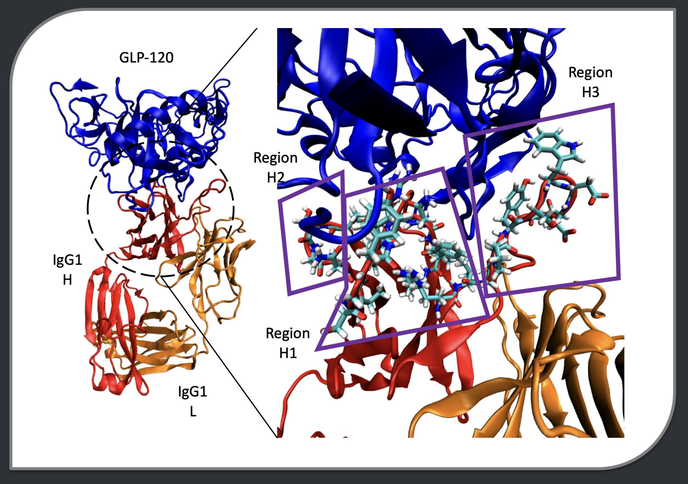


THERMOMECHANICAL SENSORS

Microcantilevers technology is based on the cantilever mechanical response after interacting with an analyte, either as a resonance frequency shift (dynamic mode) or a deformation-bending (static mode). The dynamic mode has been applied to analyze different binding affinities and the static mode has been employed to study the thermal transitions of proteins and polymers deposited onto the cantilever surface.

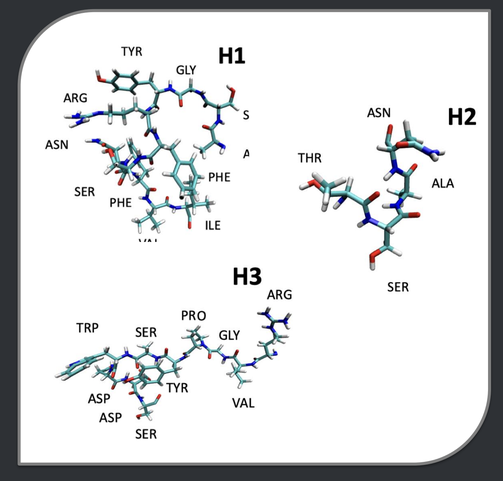


COMPUTER MODELLING



Use of advanced simulation methods in order to study the biological processes that take place in the biomaterials interfaces.

One of the latest projects includes the study of an inmunosensor. The employed methodology combines conventional Molecular Dynamics (MD) simulations with Quantum Mechanichs/Molecular Mechanics (QM/MM) approaches to follow protein-protein interaction between the human antibody IgG1 (colored in red and orange its branches) and the linking protein of the HIV virus, GP-120, (colored in blue). All the system were studied with MD and every time step making quantum calculations of the forces for all the atoms in 3 different regions (H1, H2, H3), these 3 regions dock both proteins.



Recent representative publications:

Puiggalí-Jou, A. *et al.* "Drug Delivery Systems Based on Intrinsically Conducting Polymers". *J. Control. Release* **2019**, *309*, 244.

Molina, B. G. *et al.* "Electrochemical Sensor for Bacterial Metabolism Based on the Detection of NADH by Polythiophene Nanorparticles". *J. Phys. Chem. C* **2019**, *123*, 22181.

Molina, B. G. *et al.*"Free-Standing Faradaic Motors Based on Biocompatible Nanoperforated Poly(lactid Acid) Layers and Electropolymerized Poly(3,4-ethylenedioxythiophene)". *ACS Appl. Mater. Interfaces* **2019**, *11*, 29427.

Revilla-López , G. *et al.* "Biominerals Formed by DNA and Calcium Oxalate or Hydroxyapatite: A Comparative Study". *Langmuir* **2019**, *35*, 11912.

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