Istituto di Chimica dei Composti Organometallici
Consiglio Nazionale delle Ricerche

Venerdì 5 settembre 2025
alle ore 11:30

presso AULA 2 dell'Edificio F
Area della Ricerca CNR di Firenze
Via Madonna del Piano 10, Sesto Fiorentino

la Dr.ssa Anna Maria Ferretti
Istituto di Scienze e Tecnologie Chimiche "Giulio Natta" (SCITEC),
Consiglio Nazionale delle Ricerche (CNR),
Via G. Fantoli 16/15, Milano, 20138, Italia

terrà il seguente seminario:

"Nanostructured Polymers for Energy Harvesting and Environmental Applications"

Si invitano tutti gli interessati a partecipare.

Dr. Claudio Sangregorio
Direttore ICCOM

Short Abstract:

Polymer-based nanostructured materials are receiving growing attention for their role in sustainable energy technologies and environmental remediation. In this seminar, we will present recent advances in the design and application of these materials for photovoltaic cells, emphasizing their multifunctional potential in energy conversion and CO_2 valorization. Thanks to their tunable properties, lightweight nature, and compatibility with flexible substrates, polymeric nanomaterials offer unique advantages for next-generation solar cells. A particularly innovative approach involves the development of water-compatible nanoparticles (WPNPs) derived from hydrophobic conjugated polymers, with promising applications across optoelectronics, biology, and medicine. Our work focuses on the creation of stable, water-processable nanoparticles with controlled shape and internal structure, achieved through the use of amphiphilic low-band-gap rod-coil block copolymers (LBG-BCPs). These WPNPs were synthesized via a modified miniemulsion technique that eliminates the need for surfactants and significantly reduces the use of halogenated solvents. Additionally, we developed semiconductor blend-WPNPs by combining BCPs with suitable fullerene derivatives. Advanced characterization techniques such as TEM, EFTEM imaging, and STEM-EDX analysis provided detailed insights into the morphology and elemental distribution of the nanoparticles at the nanoscale, which is crucial for understanding the self-assembly behavior of LBG-BCPs into WPNPs. We will explore two key applications of WPNPs, a s active layers in Organic Photovoltaic (OPV) devices and as photosensitizers in artificial photosynthesis systems for CO_2 valorization.

In addition, ongoing work will be presented on the development of novel polymer based nanostructured materials for CO2 valorization.

Biographic sketch:

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I have since expanded my expertise to the synthesis and characterization of polymer-based nanoparticles, leveraging this knowledge to develop heterostructured nanomaterials that combine properties of inorganic NPs with the capabilities of polymer-based systems. This strategy is aimed at creating novel composite materials with unique and enhanced functionalities. At the same time, I have remained active in the characterization of magnetic materials, with a particular focus on reducing the reliance on Critical Raw Materials (CRM).

Early research, from 1998 to 2009, focused on the chemical-physical characterization of paramagnetic centers using advanced EPR techniques. A year-long research stay at ETH Zurich occurred during the 2001–2002 academic year. From 2003 to mid-2009, she worked at INFM using applied pulsed and continuous-wave EPR to investigate paramagnetic centers in semiconductors and oxides, with application in microelectronics and quantum computing.

In 2009 she joined ISTM-CNR (now SCITEC-CNR). Since then the research focused on nanostructured materials, specifically the design and characterization of nanoparticles, including magnetic oxides, metallic nanostructures (Ag, Au), core-shell systems, and composites for electromagnetism and piezo-magnetic applications. Expertise in Transmission Electron Microscopy (TEM) and microanalytical techniques such as EELS, STEM-EDX, ESI, and STEM has

been developed, applied to inorganic nanomaterials, block-copolymer systems, and biological samples, including extracellular vesicles.
More recently, she dedicated to polymer-based nanostructures, particularly for Organic Photovoltaics, and to the synthesis and characterization of hybrid materials combining magnetic or catalytic properties with the transport behavior of polymers. Efforts have also focused on reducing reliance on Critical Raw Materials (CRM) in magnetic materials. Over the past eight years, I have also participated in third mission activities, promoting knowledge dissemination and public engagement.