Institut de Nanociència i Nanotecnologia | UNIVERSITAT DE BARCELONA

IN²UB INTERNATIONAL RESEARCH SEMINAR

"Magnetically driven micro- and nanoswimmers"

By, **Prof. Dr. Salvador Pané i Vidal**, Institute of Robotics and Intelligent Systems (IRIS), Swiss Federal Institute of Technology (ETH) Zurich

October 27th at 12h – Telematic session by BB *Collaborate*

We live in a world increasingly surrounded by robots such as robotic surgical systems, flying drones, autonomous planetary rovers, and robotic appliances. An emerging family of robotic systems are untethered micro- and nanorobots. These tiny vehicles can move either by harvesting chemical fuels present in their swimming environments or by means of external energy sources. One of the ultimate goals of small-scale robotics is to develop machines that can deliver drugs, or realize other medical missions in confined spaces of the human body. Other applications include water remediation or "on-the-fly" chemistry. The recent rapid developments in small-scale robotics is undeniably related to advances in material science and manufacturing. However, while many applications have been demonstrated, aspects such as complex locomotion, multifunctionality, biocompatibility and biodegradability need to be further investigated for the successful translation of these devices to real applications. To this end, new material-based concepts and novel fabrication schemes are urgently required.

In this talk, I will introduce two of my latest developments in small-scale robotics. In the first part, we will show how 3D printed microtemplates can be exploited to produce complex robotic microstructures made of rigid metals, soft polymers and combinations of these. As a result, topologically complex metal-organic structures can be realized with sub-micrometric resolution. I will also demonstrate that metal-organic interlocked micromachines can solve several practical challenges in small-scale robotics. We show that high magnetic responsiveness, drug loading capabilities, biocompatibility, on-demand shape transformation, and multi-locomotion modes can be embedded in a single microrobotic machine. The second part of this talk will be focused on multiferroic small-scale robots. These small-scale robots consist of multiferroic magnetoelectric composite materials, which have the ability to generate an electric field under the application of an external magnetic field. Micro and nanorobots capable of wirelessly delivering electric fields can be used for electrostimulation of cells for the central nervous systems applications, or for bone tissue engineering. Finally, magnetoelectric small-scale robots can also be used for water cleaning applications, such as degradation of organic pollutants or reduction of heavy metals.