Title: Synthesis and functionalization of magnetic nanoparticles for magnetic hyperthermia applications

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ABSTRACT: Magnetic nanoparticles (MNPs) have unique properties that can be used for different (bio)applications, such as magnetic separation, magnetic resonance imaging (MRI), therapy (for example, magnetic hyperthermia) and controlled release of drugs.

In this talk, I will describe the synthesis and functionalization of MNPs with (bio)molecules of interest (carbohydrates, polyethylene glycol, strained alkynes, proteins, etc.), followed by some examples of biomedical applications of these MNPs, focusing on magnetic hyperthermia.

In “classical” magnetic hyperthermia, the heat generated by the MNPs under the application of an alternating magnetic field is used to induce the death of tumoral cells. Using 3D cell culture models, we have shown that it is possible to modulate the cell death mechanism (apoptosis vs. necrosis) by controlling the localization of the MNPs inside the cell culture model (Beola et al., ACS Appl. Mater. Interfaces 2018, 10, 44301).

Recently, we proposed a disruptive use of the magnetic hyperthermia for the control and manipulation of the biophysical properties of cellular membranes using long-lived attachment of MNPs to the cell membrane. Our hypothesis is that with this particular subcellular MNP localization, controlled changes of membrane biophysics would be obtained without compromising cell viability. In this talk, I will discuss the immobilization of MNPs on the membrane of living cells using two different strategies - covalent linking via bioorthogonal strain-promoted “azide-alkyne cycloaddition (SPAAC) and non-covalent union using cell adhesion proteins, respectively.

SUMMARY OF THE CV: Chemical Engineer (2000) and PhD in Chemistry (2005), "Politehnica" University Bucharest, Romania. Marie Curie predoctoral stay at the University of the Basque Country.

After several postdoctoral stays at the University of the Basque Country (Spain) and at the University of Twente, Enschede, the Netherlands, Dr Fratila joined the Nanotherapy and Nanobiosensors group (Institute of Nanotechnology of Aragón) in 2013 as a Marie Curie COFUND (ARAlD-EU) researcher. In 2015, she was awarded a prestigious Marie-Sklodowska Curie fellowship at the Institute of Materials Science of Aragón to open a new research line focused on the development of bioortogonal “click” reactions for applications in magnetic hyperthermia. Since 2017, Dr Fratila is a Ramón y Cajal researcher at ICMA. Her main research line is devoted to the use of bioortogonal "click" chemistry in nanotechnology. Her other research lines include: the development of platforms for the controlled release of drugs using magnetic hyperthermia, the study of the biodistribution and biodegradation of magnetic nanoparticles, or the advanced characterization of nanomaterials by transmission electron microscopy techniques.

Dr Fratila has co-authored more than 40 articles and book chapters, she is co-inventor of a patent and has more than 60 contributions to national and international congresses. She
is the editor of the book "Nanomaterials for Magnetic and Optical Hyperthermia Applications" (Elsevier, 2018).