ORGANIC-INORGANIC MAGNETIC HYBRIDS AS MULTIFUNCTIONAL IMAGING AND THERAPEUTIC AGENTS

M. Bañobre-López, Advanced (magnetic) theranostic nanostructures Group, International Iberian Nanotechnology Laboratory, INL, Braga,
manuel.banobre@inl.int
J. Gallo, Advanced (magnetic) theranostic nanostructures Group, International Iberian Nanotechnology Laboratory, INL, Braga
C. L. Moura, Advanced (magnetic) theranostic nanostructures Group, International Iberian Nanotechnology Laboratory ; Department of Organic and Inorganic Chemistry, Federal University of Ceará, Brazi
N. M. P. S. Ricardo, Department of Organic and Inorganic Chemistry, Federal University of Ceará, Brazil
N. J. Long, Department of Chemistry, Imperial College London, UK.

Magnetic iron oxide nanoparticles (SPIONs) have become key elements in the design of functional nanostructures able to play an active role in different biomedical applications, e. g. as heat generating nanosources in magnetic hyperthermia, as contrast agents in magnetic resonance imaging (MRI), in drug delivery and cell separation, and in biosensing. On the other hand, polymeric nanostructures have received great interest as suitable bioactive encapsulating agents and carriers due to their biocompatibility, low toxicity and ability to influence the bioactive delivery profile [1]. In a further step, hybrid organic-inorganic nanocomposites have been explored as a synergistic approach that combines the modified bioactive release induced by the polymer/lipid encapsulation and the intrinsic physico-chemical properties from the inorganic counterpart [2]. In particular, magnetic hybrid self-assemblies have been found to open new perspectives for biomedical and environmental applications [3, 4].

Here, I will discuss about the synthesis and properties of unconventional organic-inorganic magnetic hybrids as an approach towards an earlier and more accurate diagnosis and therapy of disease. On one hand, relevant results will be presented on the rational design of the ideal dual-mode T_1/T_2 MRI system, involving the covalent organic attachment of aT_2 (magnetic nanoparticle) and a T_1 (paramagnetic ion) moieties [5]. On the other, the multifunctional performance of magnetic hybrid solid lipid nanocomposites (MSLNs) dual loaded with a bioactive compound and SPIONs, as ultra-high T_2-MRI contrast agents and heat generating sources through magnetic hyperthermia, will be also discussed. Interestingly, the incorporation of SPIONs into these hybrid nanocomposites results in a very significant enhancement of their T_2-MRI imaging capabilities, with transversal relaxivity (r_2) values above 900 $mM(Fe)^{-1}s^{-1}$, and enables the generation of modified drug release profiles through the application of oscillating magnetic fields.

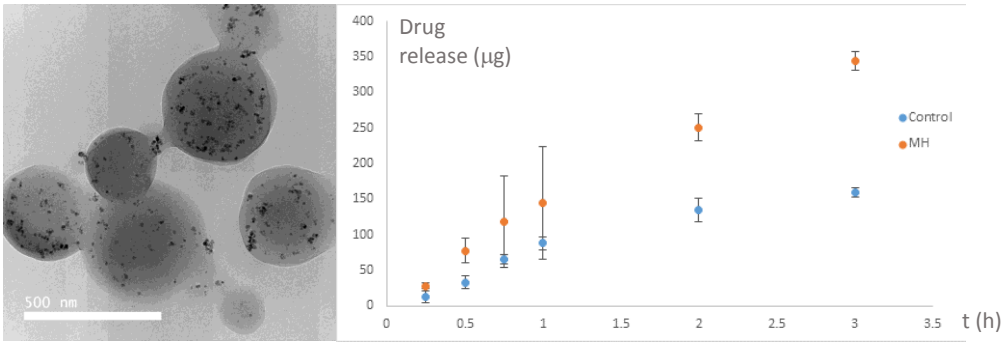

Figure 1. (Left) Organic-inorganic magnetic solid lipid nanoparticles. (Right) Drug delivery profiles without and with applying magnetic hyperthermia.

[1] M. Elsabahy and K. L. Wooley. Chem. Soc. Rev., 2012, 41, 2545.
[2] A. P. R. Johnston, G. K. Such, and F. Caruso. Angew. Chem. Int. Ed. 2010, 49, 2664.
[3] C. Sanson , O. Diou, J. Thévenot, E. Ibarboure, A. Soum, A. Brûlet, S. Miraux, E. Thiaudière, S. Tan, A. Brisson, V. Dupuis, O. Sandre and S. Lecommandoux. ACS Nano 2011, 5 (2), 1122.
[4] A. Pavía-Sanders, S. Zhang , J. A. Flores, J. E. Sanders, J. E. Raymond and K. L. Wooley. ACS Nano, 2013, 7 (9), 7552.
[5] N. A. Keasberry, M. Bañobre-López, C. Wood, G. J. Stasiuk, J. Gallo and N. J. Long. Nanoscale, 2015, 7, 16119.