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Magnetic Glyconanoparticles as MRI Probes

Marco Marradi, Isabel García, Juan Gallo, Ainhoa Irure, and Soledad Penadés
Laboratorio de GlicoNanotecnología, CIC biomaGUNE/CIBER-BBN, Parque Tecnológico de San Sebastián, Pº de Miramón 182, 20009 San Sebastián
mmarradi@cicbiomagune.es

The construction of novel multifunctional bionanomaterials that can help in better understanding life processes at the nanoscale and with potential applications in medicine is a key challenge of nanotechnology. Our group has experience in preparing gold and magnetic nanoclusters, and semiconductor nanocrystals functionalized with different types of carbohydrates (glyconanoparticles). [1]

The aim of this talk is to present our results on the preparation, characterization and applications of magnetic glyconanoparticles as biocompatible, biofunctional and water-soluble probes for Magnetic Resonance Imaging (MRI). In the area of MRI, magnetic nanoparticles have demonstrated to be highly sensitive and target-specific contrast agents for observing biological events both at cellular and molecular level. [2]

For engineering magnetic glyconanoparticles, we have designed two approaches (Figure 1). The first approach is based on the development of novel core@shell bimetallic ferrites (Fe, Mn, Co, Au) coated with amphiphilic carbohydrate derivatives as superparamagnetic T_2-contrast agents. These biocompatible nanomaterials are superparamagnetic at room temperature and present similar, or higher, transversal relaxivities (r_2) than commercial contrast agents currently in clinical use as Resovist® and Endorem®. By further functionalization of the organic shell with antibodies, contrast agents for selective labelling and tracking specific cells have been obtained.

The second approach converts gold glyconanoparticles into paramagnetic probes (T_1-contrast agents) by modifying the organic shell through insertion of Gd(III) chelates (Figure 1). In this way, it was possible to obtain biocompatible paramagnetic glyconanoparticles which present similar, or higher, longitudinal relaxivities (r_1) than commercial contrast agents currently in clinical use as Dotarem® and Magnevist®. [3] Their application in the detection of glioma in murine models in vivo will be presented.

References:

[1] For a leading review, see: J. M. de la Fuente and S. Penadés, *BBA-Gen. Subjects*, **1760** (2006) 636.
[2] Y. W. Jun, J. H. Lee and J. Cheon, Chemical design of nanoparticle probes for high-performance magnetic resonance imaging, *Angew. Chem. Int. Ed. Engl.*, 47 (2008) 5122.
[3] M. Marradi, D. Alcántara, J. M. de la Fuente, M. L. García-Martín, S. Cerdán and S. Penadés, Chem. Commun., **26** (2009) 3922.

Figures:

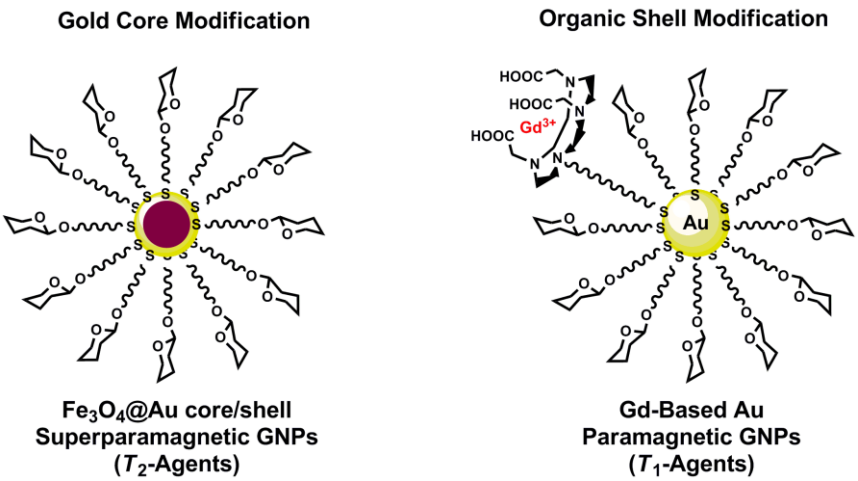

Figure 1. Schematic representation of prepared magnetic glyco-ferrites and Gd-based glyconanoparticles as MRI probes.