Magnetic/plasmonic $MnFe_2O_4$/Au nanoparticles covered with lipid bilayers for applications in thermotherapy

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The potential of magnetic nanoparticles for biomedical applications has been recognized due to their unique size and physicochemical properties. Nanoparticles with superparamagnetic behavior are preferred for these purposes, as they exhibit a strong magnetization only when an external magnetic field is applied. [1]

The coverage of nanoparticles with a lipid bilayer improves biocompatibility, preserving the magnetic properties, while providing the ability to transport drugs. Recently, magnetic nanoparticles of manganese ferrite covered with a lipid bilayer were developed. [2] Plasmonic gold nanoparticles exhibit strong photothermal effects, [3] producing local heat that can be exploited for hyperthermia and controlled drug release applications. The combination with superparamagnetic behavior adds the possibility of effective guidance of the nanoparticles to the site of interest by using an external magnetic field.

In this work, three different types of magnetic/plasmonic nanoparticles were prepared: core-shell nanoparticles with a manganese ferrite core and a gold shell; plasmonic gold nanoparticles decorated with magnetic nanoparticles of manganese ferrite; and magnetic nanoparticles of manganese ferrite decorated with plasmonic gold nanoparticles. The structural, spectroscopic and magnetic properties of these nanoparticles were evaluated.

In order to further develop applications in cancer therapy, the prepared mixed nanoparticles were covered with a lipid bilayer. The local heating capability of these nanosystems was tested through the quenching of rhodamine fluorescence incorporated in the lipid layer, using excitation with a Xenon arc lamp. The quenching of rhodamine emission is caused by the increase in non-radiative deactivation processes, that results from the local heating promoted by the nanoparticles. Promising results were obtained for the core-shell $MnFe_2O_4$/Au nanoparticles and for those containing $MnFe_2O_4$ decorated with plasmonic gold nanoparticles (Fig. 1).

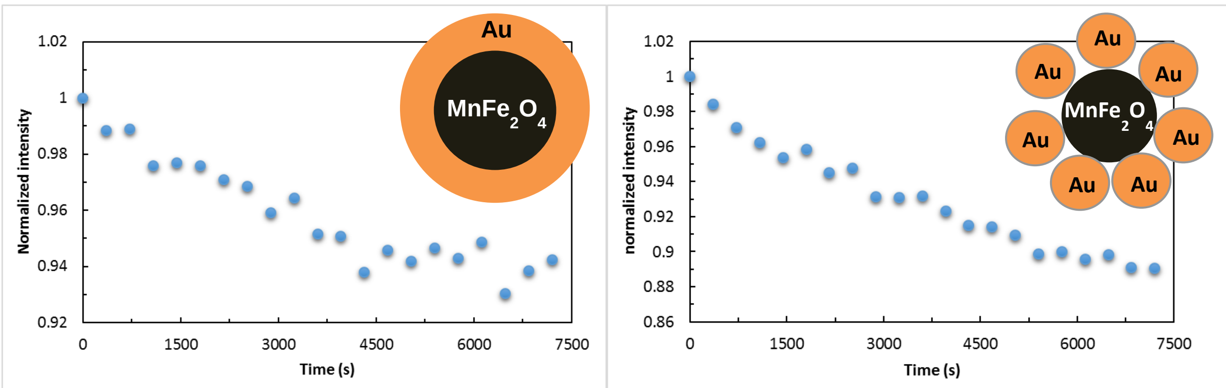

Fig. 1: Variation of fluorescence intensity of rhodamine with time, during irradiation, for mixed $MnFe_2O_4$/Au nanoparticles covered with a lipid bilayer.
Left: Core-shell $MnFe_2O_4$/Au nanoparticles; *Right:* $MnFe_2O_4$ nanoparticles decorated with gold nanoparticles.

1) A. Hervault *et al*., *Nanoscale*, **2014**, *6*, 11553.
2) A. R. O. Rodrigues *et al.*, *RSC Advances*, **2016**, *6*, 17302.
3) M.-J. Chiu *et al*., *Phys. Chem. Chem. Phys*., **2015**, *17*, 17090.

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