Thermosensitive Magneto-Fluorescent Nanoplatforms with Great Heating Power

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Nanosystems that simultaneously contain magnetic and fluorescent modules can offer decisive advantages in the development of new biomedical technologies. Magnetite NPs-based structures have shown a lot of potential in magnetically-driven diagnostic and therapeutic modalities, such as magnetic resonance imaging (MRI) and magnetic hyperthermia (MH), respectively[1]. On the other hand, Rhodamine 3B is a biocompatible fluorophore whose emissive properties are pH independent (above 6) and insensitive to the ionic strength, but presents fluorescence quantum yield that linearly decreases with temperature[2]. There is not doubt that a nanomaterial that includes efficient nanoheaters together with luminescence and an intrinsic temperature sensor would become a promising theranostic agent. In this work, we have developed a magneto-fluorescent nanoplatform that incorporates Fe_3O_4 NPs with large magnetothermal actuation and thermosensitive rhodamine (Rh) molecules that have the ability to self-monitor the hyperthermia degree (Figure 1). The size (∼25 nm) and shape (octahedral-like) of the magnetite NPs have been finely tuned (Figure 1a) in order to reach an optimal heating capacity within the clinical safety limits (≈ 1000 W/g at 142 kHz and 44 mT). Several copolymers formed by poly(maleic anhydride-alt-1-octadecene) (PMAO), polyethylene glycol (PEG) of high molecular weight and Rh have been prepared to coat the magnetite cores and avoid strong dipolar interactions among NPs. The optical study has revealed that copolymers synthesized with PEG of 20 kDa and a 10 % rhodamine fulfill the best compromise to achieve Fe_3O_4@Rh nanoplatforms with good fluorescent efficiency, minimal aggregation and suitable thermosensitivity (0.9 % °C^{-1}) (Figure 1d).

References

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[2] Moreau, D.; Lefort, C.; Burke, R.; et.al. *Biomed.Opt. Express* 2015, *6* (10), 4105−4117.

Figures

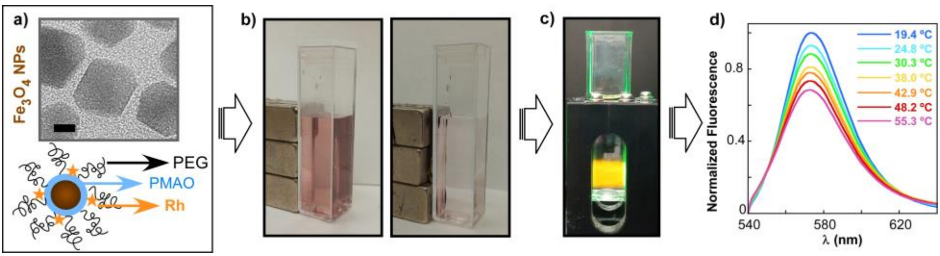

Figure 1. a) TEM image (scale bar 10 nm) and a drawing of the Fe_3O_4@Rh nanoplatforms, **b)** Fe_3O_4@Rh colloid close to a magnet (inicially and after 24 h), **c)** fluorescence emission of a Fe_3O_4@Rh sample and **d)** the evolution of the fluorescence at different temperatures.