Coating of pure iron nanoparticles: towards a more efficient agent for hyperthermia

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Abstract

Major breakthroughs on the design of nanoparticles (NPs) for theranostic purposes have been reported over the past years.[1] Among all the different techniques available that enable NPs-mediated treatment, magnetic hyperthermia appears as a powerful one. Indeed, many reports have showed that iron oxides particles can efficiently increase locally the temperature and kill malignant cells either *in vitro* or *in vivo*.[2] One other material of interest is pure iron NPs which exhibit a higher saturation magnetization than the iron oxides generally used. Indeed, using iron would permit to obtain values of the Specific Absorption Rate (SAR) more than two times larger than the ones obtained with its classical oxide counterparts (Figure 1a).[3] However, the use of these NPs for treatment needs water transfer where one great challenge is to avoid the oxidation of the metal and thus the loss of the magnetic properties. To tackle this phenomenon, we have developed an efficient protocol to perfectly coat the metallic particles with a silica shell in a non alcoholic media.[4] Here, we will describe in details this approach applied to Fe NPs (Figure 1b) and show that whatever the thickness of the coating, the iron core of the particles is preserved. Moreover, depending on the experimental conditions, it is possible to modulate the number of NPs encapsulated and to independently study magnetic coupling between the metallic cores. One last important point is the transfer of these nanomaterials in biological media and we will present an overview of our recent findings. Finally, we will explain how the control of the surface functionalization as well as the NPs aggregation will be of great importance for future hyperthermia measurements performed *in vitro*.

References

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Figures

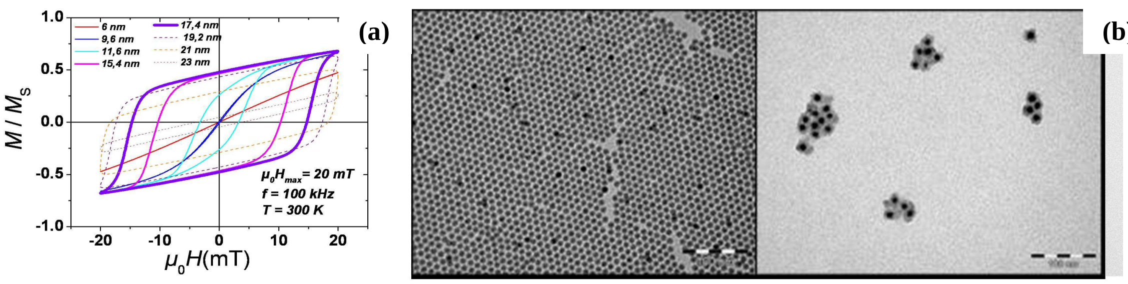

Figure 1: (a) hysteresis loops calculated for different diameters of Fe NPs; (b) TEM micrographs of Fe(0) NPs before and after coating.