Magnetic nanoparticles covered by or entrapped in lipid bilayers: Advances towards dual cancer therapy

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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]

Magneto-sensitive liposomes can be obtained by the encapsulation of magnetic nanoparticles into liposomes or, alternatively, by the coverage of magnetic particles with a lipid bilayer. Considering the promising applications of the so-called magnetoliposomes in biomedicine, a new therapy is emerging, involving the magnetically-guided transport of drugs (most of them toxic and with systemic side effects) and focusing them in specific sites of the human body. These nanosystems make possible to explore the synergistic effect between chemotherapy and magnetic hyperthermia, giving rise to a dual therapy of cancer.

Recently, both aqueous magnetoliposomes (magnetic nanoparticles entrapped in liposomes) and solid magnetoliposomes (a cluster of particles covered by a lipid bilayer) have been developed, containing either nickel/silica core/shell nanoparticles,[2] nickel ferrite,[3] or manganese ferrite nanoparticles,[4] with diameters below 150 nm, suitable for biomedical applications (Fig. 1A,B). Moreover, both aqueous (AMLs) and solid (SMLs) magnetoliposomes show a superparamagnetic behavior, the SMLs exhibiting a high saturation magnetization (Fig. 1C).

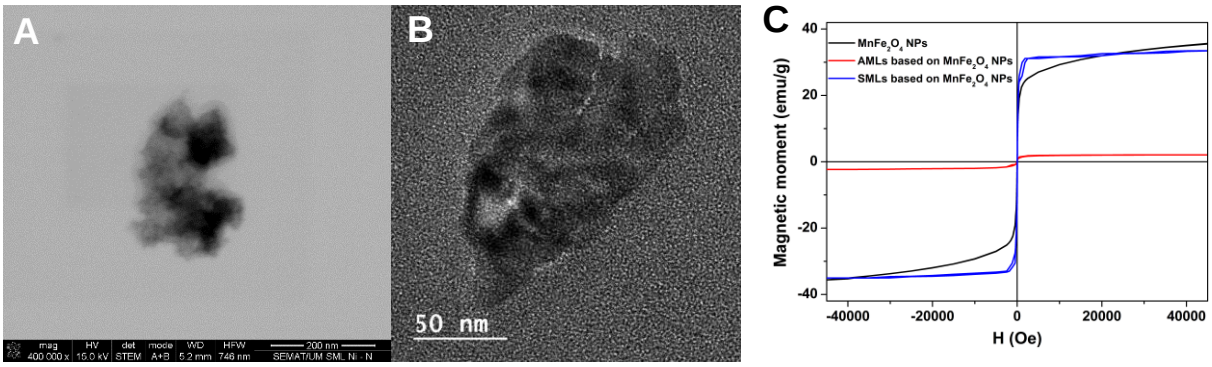

Fig. 1 A: SEM image of SMLs containing $NiFe_2O_4$ nanoparticles (with negative staining). **B**: TEM image of SMLs containing $MnFe_2O_4$ nanoparticles. **C**: Magnetization hysteresis cycles, measured at 316 K, of $MnFe_2O_4$ nanoparticles, SMLs and AMLs containing $MnFe_2O_4$ nanoparticles.

New promising antitumor drugs (thienopyridine derivatives), active against several human tumor cell lines *in vitro*, were sucessfully incorporated in these magnetic nanosystems,[4] with high encapsulation efficiencies, pointing to a promising application of these systems as nanocarriers for antitumor drugs and as therapeutic agents in combined thermo/chemotherapy of cancer.

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3) A.R.O. Rodrigues *et al.*, *Phys. Chem. Chem. Phys*, **2015**, *17*, 18011.
4) A.R.O. Rodrigues *et al.*, *RSC Advances*, **2016**, *6*, 17302.

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