Role of particle-intrinsic parameters, experimental conditions and interactions in magnetic fluid hyperthermia

Daniela Paola VALDÉS - *Instituto de Nanociencia y Nanotecnología & Universidad Nacional de Cuyo, Argentina*

Many works have provided a deeper insight into the power absorption of single-domain magnetic nanoparticles (MNP) in magnetic fluid hyperthermia (MFH), both through experimental and theoretical approaches. However, the role of all parameters relevant to the magnetic relaxation remains a matter of debate. Particularly, there are contrasting results on the effect of interactions for elongated arrangements, reporting beneficial and detrimental effects on the specific power absorption (SPA).

Through the simulation of MNP systems with different particle-intrinsic parameters (size, anisotropy) and experimental conditions (frequency, interactions), we determined four regions (I-IV) of magnetic behavior as a function of relative anisotropy (anisotropy field with respect to the amplitude of the ac field), that dictate the SPA in MFH experiments.

The limits between regions change with all of these parameters. We analyzed elongated MNP arrangements and found out that, for the low relative anisotropy range, dipolar interactions increase the SPA while they are detrimental for the range of high relative anisotropy. This resolves seemingly contradictory results of interaction effects in this kind of aggregates reported in the literature. We explained the mechanism involved in the enhancement of the SPA by dipolar interactions at the low anisotropy regime, which is related to an increase in coercivity caused by the shift between the local and the applied magnetic field.

We also provided a simple, analytical tool aimed at the design of MNPs and the choice of the experimental conditions for optimal heating. Through the thermal interpretation of its validity range, we conclude that systems with low-thermal-fluctuation influence are the best candidates for MFH due to their high SPA values.