

Evaluating the magnetic anisotropy temperature dependence of (SPIONs) system

J.C. Martinez Garcia¹, F. Crippa¹, C. A. Monier¹, A. M. Hirt², A. P. Fink¹, M. Lattuada¹

¹Adolphe Merkle Institute, University of Fribourg, Chemin des Verdiers 4, CH-1700 Fribourg, Switzerland, ²Institute of Geophysics, ETH Zürich, Sonneggstrasse 5, 8092 Zürich, Switzerland

Magnetic hyperthermia (MH) is based on the release of heat and consequent temperature increase by magnetic nanoparticle (MNPs) exposed in an alternating magnetic field. MH is a promising technique in cancer treatment because it causes less damage than chemotherapy or radiotherapy. Active research is being done to improve the specific adsorption rate (SAR), i.e., the amount of heat released per unit mass of MNPs, which could permit the treatment of tumors of small size [1] and could reduce the amount of material that must be injected into a tumor. The specific absorption rate is extremely sensible to the change of the magnetic anisotropy constant (K_V) which is so far for the case of magnetic nanoparticles assumed as an independent temperature parameter. To elucidate it, three important questions are fundamental to be addressed: How to K_V directly from the dynamic behavior of magnetic nanoparticles? Will be K_V affected by the temperature effect? How K_V could affect the magnetic hyperthermia? By applying a model free route approach [2,3] we have determined K_V in superparamagnetic iron-oxide-magnetic-nanoparticles (SPIONs) systems directly from the magnetic susceptibility data. We found a strong dependence between K_V and T as well as a strong discrepancy with the universal assumed value of infinity relaxation time

[1] R. E. Rosensweig, *J. Magn. Magn. Mater.*, vol. 252, pp. 370–374, 2002. A. P.Khandhar, R. M. Ferguson, J.A. Simon, and K.M.Krishnan, *J. Appl. Phys.*, vol. 111, pp. 07B306-1–07B306-3, 2012

[2] Martinez-Garcia, J. C.; Martinez-Garcia, J.; Rzoska, S. J.; Hulliger, J. *The Journal of chemical physics* 2012, 137 (6), 064501.

[3] Martinez-Garcia, J. C.; et.al.,. *Nat Commun* 2013, 4, 1823. Martinez-Garcia, J. C, et al. *Scientific Reports* 2014, 4, 5160. Martinez-Garcia, J. C.;et.al. *Sci. Rep.* 2015, 5.

[4] C. A. Monnier, M. Lattuada, D. Burnand, F. Crippa, J. C. Martinez-Garcia ,A. M. Hirt, B. Rothen-Rutishauser, M. Bonmarin and A. Petri-Fink, *Nanoscale* 2016 (under revision)