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Studies on enhanced colloidal stability and heating ability of glycine functionalized LSMO nanoparticles for cancer hyperthermia therapy

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Magnetic properties

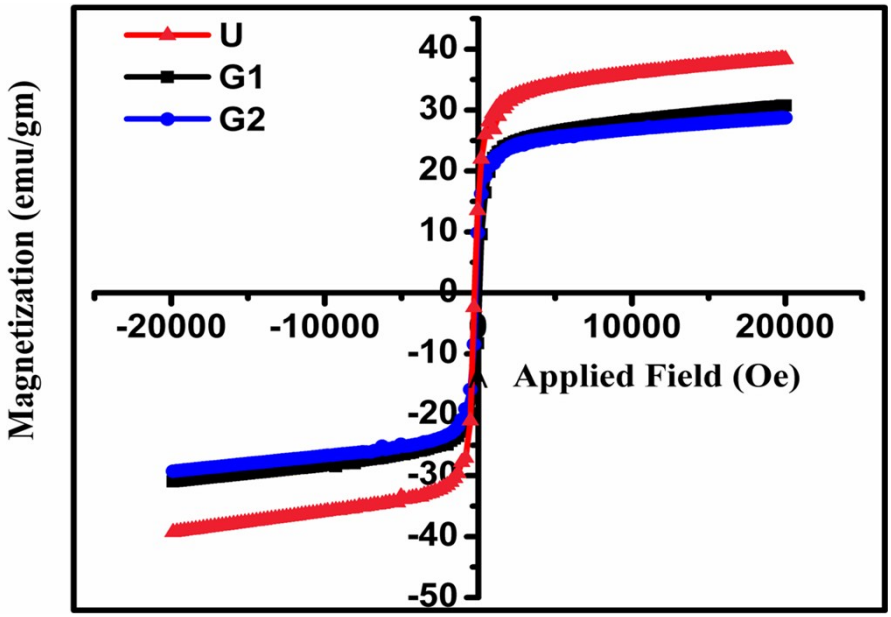

Fig. S1 M-H curves of uncoated (U), glycine monolayer coated (G1) and glycine bilayer coated (G2) LSMO NPs measured at room temperature.

Fig. S1 shows typical (vibrating sample magnetometer) VSM magnetization hysteresis curve at room temperature for the synthesized MNPs. The loops aspect indicates the prepared NPs are superparamagnetic; with negligible coercivity (13.35, 11.05, 10.46 Oe) and negligible remanence (6.7, 5.4, 5.2 emu/g). This is attributed to the fact that the MNPs included in the polymer matrix were so small that they may be considered to have a single magnetic domain. The saturation magnetizations of the MNPs in the study are found to be 35.20, 31.35 and 29.14 emu/g for uncoated, monolayer and bilayer coated LSMO NPs respectively. Magnetization decreased with coating of glycine, this is because magnetization is proportional to the amount of weight for the same magnetic material. Organic coating (glycine) layers on magnetic material increases the amount of non-magnetic substance which reduces the overall magnetization of the material. Khot *et al* reported the reduction in magnetization for coated sample may be attributed to the presence of a non-magnetic

dextran coating layer onto the surface of NPs which reduces the particle–particle interaction and lowers the exchange coupling energy which in turn reduces the magnetization. [1] Shete *et. al*. reported the reduced magnetization in AP-coated MNPs could also result from the small particle surface effect which refers to the disordered alignment of surface atomic spins induced by reduced coordination and broken exchange between surface spins. This surface effect is more noteworthy in small particles as the ratio of surface atoms to the interior atoms increases with a decrease in particle size. [2] Patil *et. al.* indicated organic coating chitosan/glutaraldehyde layers on magnetic material increases the amount of non-magnetic substance which reduces the overall magnetization of the material [3].

References

[1] V.M. Khot, A.B. Salunkhe, N.D.Thorat, R.S. Ningthoujam, S.H. Pawar, Induction heating studies of dextran coated $MgFe_2O_4$ nanoparticles for magnetic hyperthermia, Dalton Trans. 42 (2012) 1249.

[2] P.B. Shete, R. M. Patil, R. S. Ningthoujam, S. J. Ghosh and S. H. Pawar, Magnetic core–shell structures for magnetic fluid hyperthermia therapy application, New J. Chem. 37 (2013) 3784.

[3] R.M. Patil, P.B. Shete, N.D. Thorat, S.V. Otari, K.C. Barick, A. Prasad, R.S. Ningthoujam, B.M. Tiwale, S.H. Pawar, Superparamagnetic iron oxide/chitosan core/shells for hyperthermia application: Improved colloidal stability and biocompatibility, J. Magn. Magn. Mater. 355 (2014) 22.