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Study of Magnetic Dumbbell nanoparticles using advanced scattering techniques

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Magnetic dumbbells consist of a noble metal seed linked to a magnetite nanoparticle. Self-assembly of nanoparticles in general, is of interest due to its broad range of applications in material science and biomedical engineering. Parameters that affect self-assembly of nanoparticles include particle size, thickness of surfactant and concentration but additional parameters such as composition of the seed, the interface between seed and magnetite, shape anisotropy and magnetic structure also influence self-assembly of dumbbells induced by magnetic fields. In order to understand the parameters that influence self-assembly of dumbbells, we must first investigate self-assembly in single phase magnetite nanoparticles. Our studies on magnetic nanoparticles with 16nm and 27nm diameter from small-angle neutron scattering reveal a profound size effect on self-assembly. These measurements will act as a reference for future studies of dumbbells with comparable parameters. We will discuss our assessment of the complete magnetic and nuclear cross-sections of the dispersed and self-assembled structures, determined from Polarisation Analysis, Polarised and unpolarised Small-Angle Neutron Scattering (SANS). SAXS on single phase nanoparticles and dumbbell nanoparticles with and without field are reported to complement the results of neutron scattering experiments. Further, magnetisation measurements on these samples reveal their blocking temperature and interesting magnetic behaviour.

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