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Small-Angle Neutron Scattering Studies of Magnetic Correlation Lengths in Nanoparticle Assemblies

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Small-angle neutron scattering (SANS) measurements of ordered arrays of surfactant-coated magnetic nanoparticle reveal characteristic length scales associated with interparticle and intraparticle magnetic ordering. The high degree of uniformity in the monodisperse nanoparticle size and spacing leads to a pronounced diffraction peak and allows for a straightforward determination of these length scales [1]. There are notable differences in these length scales depending on the particle moment, which depends on the material (Fe, Co, Fe3O4) and diameter, and also on whether the metal particle core is surrounded by an oxide shell. For 8.5 nm particles containing an Fe core and thick Fe3O4 shell, evidence of a spin flop phase is seen in the magnetite shell when a field is applied , but not when the shell thickness is $\sim$0.5 nm [2]. 8.0 nm particles with an e-Co core and 0.75 nm CoO shell show no exchange bias effects while similar particles with a 2 nm thick shell so significant training effects below 90 K. Polarized SANS studied of 7 nm Fe3O4 nanoparticle assemblies show the ability to resolve the magnetization components in 3D.

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