Mapping magnetic fields at the nanoscale in magnetic colloids

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Magnetic nanoparticles have important technological applications in a wide variety of areas, ranging from data storage and quantum computing to magnetocaloric refrigeration and cancer therapy. Common characterization techniques are applicable primarily to macroscopic assemblies of nanoparticles. In magnetic colloids, solvent-induced interactions and collective effects invariably mask the behaviors of individual nanoparticles. In such systems, conventional analysis can be misleading in terms of both the observed interactions between individual nanoparticles and their resulting geometries. By using an *in situ* fluid cell, nanoparticles can be visualized in liquid, free of the artifacts that are associated with the conventional approach.

Off-axis electron holography is a specialized technqiue that can be used for the characterization of magnetic nanostructures in the transmission electron microscope, providing insight into their magnetic properties at the nanometer scale[1]. We have applied off-axis electron holography, in combination with the use of an *in situ* fluid cell, to characterize the local magnetic properties of an aqueous colloid that contains 15 nm carboxyl-stabilized iron oxide nanoparticles.

[1]. Dunin-Borkowski, R. E.; Kasama, T.; Harrison, R. J., Electron Holography of Nanostructured Materials. In *Nanocharacterization*; Kirkland, A. I., Hutchison, J. L., Eds.; RSC Publishing, Thomas Graham House: Cambridge, UK, , p 138 (2007).