Aspects of Ferromagnetism and Phase Transformations in Nanocrystals Formed by Ion Beam Synthesis

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Ion implantation provides a versatile method to synthesize collections of nanometer-scale single crystals of a wide variety of materials embedded inside of arbitrary host substrates. In this process, high-dose ion implantation of selected chemical impurities is used to produce supersaturation of the impurities below the surface of the host so that nm-scale crystals precipitate out when the host is heated. This talk will summarize our recent experimental investigations of two types of phenomena encountered in such nanocrystal systems. First, I will contrast the magnetic behavior in systems containing nanocrystals that have a large local moment but small magnetocrystalline anisotropy (α-Fe) with that in systems of highly anisotropic particles (Fe-Pt alloys). The second example concerns the origin of a new size-dependent hysteresis observed in the semiconductor-to-metal phase transformation of a prototypical transition-metal oxide, VO_2, wherein the transformation is severely inhibited due to the small volume of the individual particles.

<u>Related reading:</u>

1. K. D. Sorge, et al., "Oriented, Single-Domain Fe Nanoparticle Layers in Single-Crystal Yttria-Stabilized Zirconia," *IEEE Trans. Magn.* **37**, 2197 (2001).
2. R. Lopez, et al., "Size effects in the structural phase transition of VO_2 nanoparticles," *Phys. Rev. B* **65**, 224113 (2002).