Physics Colloquium

Nanostructuring Effect On Novel Rare-Earth Free Magnetic Materials: From Permanent Magnets to Spintronics

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Extensive search for new magnetic materials free of critical rare-earth elements, suitable for technology or energy-applications is one of the main factors driving today's research in magnetism. Development of these new materials is often hindered by conventional bulk-synthesis techniques which result in phase mixtures or poor magnetic properties. Our research focusses on this problem by investigating an alternate approach to fabricate nanoclusters of magnetic materials using an inert-gas-condensation cluster-deposition method and analyzing their potential for magnetic applications. Also, it is often seen that reducing size of materials down to nanoscale (size ranging from 5 to 20 nm where, 1 nm = 10-9 m) brings up novel magnetic and electronic properties compared to their bulk counterparts. This phenomenon is also seen in our research which enables applications towards spintronics. Nanoclusters of hard-magnetic binary alloys were studied which have relatively high magnetocrystalline anisotropy as required for permanent-magnet applications. In-situ magnetic alignment of these nanoclusters is also demonstrated, which enhances the remanent magnetization and energy product and provides a basis to use this material as potential hard nanocomposite magnets. Mn-Si based nanoclusters were also studied, and high surface spin polarization and exotic spin-structure were demonstrated for these materials resulting in novel magnetism such as, high magnetization and Curie temperature at the nanoscale compared to bulk, and skyrmions (chiral spin ordering). These materials show potential spintronic applications such as spin-injectors, spin-polarized nano-electric devices and recording media technologies.

Everyone Welcome! Refreshments Provided.