Shaping core-shell iron oxide nanocrystals

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Over the past years, the potential applications of iron oxide nanoparticles in various fields have been widely acknowledged. Wüstite-type (FeO) nanoparticles have attracted particular attention due to their interesting defect-related magnetic properties. The formation of FeO_y, which is highly unstable at room temperature, is only achievable in the nanoscale form [1]. By controlling the oxidation process of the metastable FeO, we are able to create a core/shell type morphology of FeO/Fe_3O_4 nanostrcutures [2]. The interface between the antiferromagnetic FeO core and the ferrimagnetic Fe_3O_4 shell leads to a technologically exploitable effect known as "exchange bias"[3] (Figure 1). This makes such nanostructured materials excellent candidates for magnetic storage media.

The elevated temperature, wet-chemical techniques employed for the synthesis of our nanocrystals (Figure 2), give us the ability to tune the size and the shape of the particles. Developing the growth conditions so that particles with less-regular morphological characteristics are attained (namely, from spherical to cubic - Figure 2c), is of particular interest due to the achievable higher magnetic anisotropy of the nanomaterials. We discuss the potential of such monodisperse nanocrystals to self-assemble on appropriate substrates with the purpose to provide low-dimensional, multifunctional magnetoelectric systems.

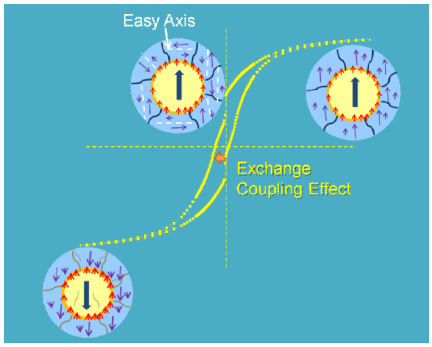

Figure 1: Schematic of the exchange-coupling effect [4].

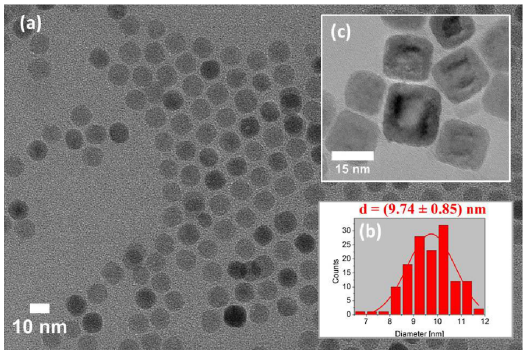

Figure 2: (a) Spherical core/shell nanocrystals exhibiting a tendency to self-assemble, (b) their size distribution and (c) high-resolution image of cubic core/shell nanoccrystals

References

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