Editorial

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# Complex Magnetic Nanostructures: A Brief Overview

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## Editorial

Nanoscale science and engineering are providing us with unprecedented understanding and control of matter at the atomic and fundamental scales. Particularly, they have attracted a significant consideration owing to their extraordinary electronic, optical, and magnetic properties that are often different from their bulk counterparts [1-5].

In the last decades, these materials have raised considerable curiosity in both basic research as well as potential industrial applications [6-10]. They have been used or discussed for a wide variety of practical applications, such as magnetic industries, optical devices, electronics, biomedical applications and biotechnology [11-14]. However, one of the most important challenges in the synthesis of nanoscale materials is how to design and prepare the desired structure with desired multi-functionality [15]. As an important family of nanoscale materials, Magnetic Nanoparticles (MNPs) with Core-Shell (CS), or dumbbell, or dimer type of structures have attracted increasing attention because of their unique functionality mainly due to the combination of interesting physical properties in the same nano-entity. Furthermore, quasi one-dimensional nanostructured materials, such as magnetic single nanowires, nanotubes and core-shell nanowires are expanding even more their capabilities.

Core-shell nanomaterials embody a very exciting constitution integrating different materials, properties and functionality into a single unit. These materials have attracted considerable interest for both fundamental science and technological applications e.g., biomedicine (*in vitro* and *in vivo*), high density magnetic recording among others [6-10]. However, the major challenge is the accurate control and tunability of both core and shell size and the chemical composition. In addition, there is also a challenging task of preparing nanoparticles and nanowires of two different materials touching each other through a small area. Today, advances in the chemical synthesis of nanoparticles have achieved significant efforts in controlling the size, composition, shape and crystallinity but still the field is in its premature stage [16].

The continuous progress in the characterization techniques as well as the advances in chemical routes allow one to fabricate more and more complex systems, whose physical properties are yet to understand. In fact, the rapid pace of technological development leads to the necessity of producing tunable devices with controlled nanostructures, even though one not fully understands the complex magnetic response of the novel systems. In turn, these systems display a very complex magnetic behavior, which is certainly the result of surface effects, magnetic interactions, and size effects, among others. From the basic viewpoint, each novel system represents a new challenge, further expanding this fascinating field.

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