Journal of Basic and Applied Engineering Research
p-ISSN: 2350-0077; e-ISSN: 2350-0255; Volume 6, Issue 4; April-June, 2019, pp. 279-280

http://www.krishisanskriti.org/Publication.html

A Review on Core/Shell Nanoparticles: Introduction and Applications

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Abstract—Nanomaterials have one or more dimension in the nanometer scale (100 nm) range and subsequently show novel properties than their bulk materials, these differ in in their characteristics thus they act differently than the bulk properties. When we consider matter at nanoscale, one of the most important to be considered is that due to the small size of the particles, these have increased surface area to volume ratio. The large value of this ratio increases the dominance of the surface atoms of the nanoparticles in relation to those in its interior. When classified on the basis of structure, the types of core/shell particles can be listed as: Spherical core/shell nanoparticles, hexagonal core/shell nanoparticles, multiple small core materials coated by single shell material, concentric material, movable core within hollow shell material. Each of this structural classification has its own importance, method of synthesis and application.The core/shell nanoparticles have some distinct features that is responsible for their importance. The properties of Core/shell nanoparticles are highly modified from that of their simple pure nanomaterials, thus they usually called highly functional materials.The layer of shell material affects the properties of the core particle by increasing or decreasing thermal stability. Thus, the shell layer increases the overall particle stability and dispersibility. So, coating on the core particle has many reasons, such as it helps in implementing surface modification, increases functionality, stability and dispensability, control on the release of the core, lowering the consumption of precious materials, and so on. These can consist of a wide range of different combinations in close interaction, including inorganic/inorganic, in organic/organic, organic/inorganic, and organic/organic materials. The choice of shell material of the core/shell nanoparticle generally strongly depends on the end application and use, i.e. the type of process, process conditions and results expected. Multiple core core/shell particles are synthesised by depositing a single shell material is coated onto many small core particles together. There are two approaches which can be used for the synthesis of core/shell nanoparticles. “TOPDOWN” APPROACH refers to the reduction of bulk material size to obtain the nanoparticles of desired shape and size; thus this uses traditional workshop techniques or micro fabrication methods to obtain the nanosized product, where specific tools are used to cut, break, mill, and shape materials into the desired product shape and order. For example, the most common techniques are lithographic techniques (e.g., UV, electron or ion beam, scanning probe, optical near field), laser-beam processing, and mechanical techniques (e.g., machining, grinding, and polishing) which reduces the size of the bulk to the desired level.“Bottom-up” approaches, on the other hand, exploit the chemical properties of the molecules to cause them to self-assemble into some useful conformation. Chemical synthesis, chemical vapour deposition, laser-induced assembly (i.e., laser tapping), self-assembly, colloidal aggregation, film deposition and growth etc come under this category.

However, the bottom-up approach can produce much smaller sized particles and has the potential to be more cost-effective in the future because of the advantages of absolute precision, complete control over the process, and minimum energy loss compared with that of a top down approach.

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