Nanoparticle Technologies: Chapter 1. Nanoparticle Fundamentals (Interface Science and Technology)

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Nanoparticles (NPs) are spherical particles with a diameter less than 100nm. They will likely become important building blocks in several industrial sectors in the future. NPs are produced under different compositions, shapes, and structures often dispersed in a medium. NPs are classified according to their composition, properties, fabrication process, or applications. A simple classification could be obtained by dividing NPs into inorganic metals, inorganic semiconductors, inorganic insulators, and, finally, organics including polymers. Other classifications are based on the nature of the manufacturing process (chemical, physical, or biological), synthesis media (gas, liquid, or solid), energy source (sputtering, laser, microwave, convection, and sonochemical), and properties (optical, mechanical, or thermal). Besides increased surface area and reactivity, smaller particles may give rise to numerous improved mechanical, optoelectronic, thermal, and magnetic properties. NPs are often used with a core–shell structure obtained following the synthesis step or a post-synthesis process. In most cases, the value chain of commercial products involving NPs consists of NP production, formulation, integration, and system assembling. Toxicity and environmental issues are considered important issues requiring more R&D and education. In particular, improved life cycle inventory and life cycle analysis for different commercial and pre-commercial NP-based products are needed.

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