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ANISOTROPIC MAGNETIC NANOPARTICLES: A REVIEW OF THEIR PROPERTIES, SYNTHESES AND POTENTIAL APPLICATIONS

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Abstract: Magnetic nanoparticles (MNPs) are of great scientific interest because of the size effect associated with their magnetic properties and, even more so, because of their wide-ranging application potential in technology and biomedicine. In this review we focus on anisotropic MNPs that exhibit (i) elongated shapes and (ii) plate-like shapes. This is because the shape and magnetocrystalline structure induce direction-dependent magnetic properties. Different synthesis strategies enable a spatially defined particle growth or assembly into an elongated shape, while the synthesis of plate-like MNPs is limited to only a few examples, e.g., hexaferrites. The control of interparticle forces is necessary to exploit the specific behaviour of anisotropic MNPs and to fabricate multifunctional materials. The assembly and/or complexation of anisotropic MNPs with other functional entities are the basis for developing direction-dependent and magnetically sensitive properties (e.g., optical, electrical, mechanical, chemical). In the first part, the magnetic properties, relevant magnetic materials and syntheses of anisotropic (in particular, elongated and plate-like) MNPs are reviewed. In the second part, the interparticle interactions, with an emphasis on the development of new, complex materials with specific behaviours, are presented. The

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