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Boosting the Performance of Magnetic Nanoparticles: Magnetic Field-assisted Assembly and Magnetic Functionalization

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ABSTRACT

Magnetic properties of single-domain nanoparticles are defined by the phase composition, particle size, and lattice/spin disorder. Beyond a single- particle level, the so-called collective effects, such as dipolar interactions, reform the magnetic properties. Recently, the organization of nanoparticles into anisotropic structures represents a smart, bottom-up approach for creating highly anisotropic magnets with mesoscopic control over magnetic anisotropy. Such architectures are of interest for many applications, like drug delivery, bioanalysis, data and energy storage, sensors, and catalysis. Recently, the magnetic field (MF)-assisted self-assembly of magnetic colloids into organized nanostructures like fibers, chains, tubes, and circles has attracted enormous attention. In this talk, the most promising strategies of MF-assisted organization of magnetic nanoparticles will be presented. Moreover, a new approach – the so-called MF-assisted click chemistry, based on the thermo reversible Diels–Alder reaction in the presence of an external MF will be introduced. This concept enables the preparation of highly anisotropic assemblies of nanosized magnets that can be reversibly decomposed by thermal treatment. Finally, a concept of hybrid nanoparticles functionalized with magnetic molecules will be introduced.