Properties of RE-TM nanoparticles prepared by inert gas condensation

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Rare earth (RE) magnets are already multiply used in our modern society. Magnetic nanoparticles of these materials provide additional promising properties for many applications, such as magnetic data storage, medical applications, magnetic mechanical actuators, sensors, or hybrid-catalysis. There are different methods to synthesize rare earth-transition metal (RE-TM) nanoparticles, such as, e.g., chemical preparation routes or surfactant-assisted ball milling. The purpose of this study is to investigate free, RE-TM nanoparticles prepared by inert gas condensation and to study how different thermodynamic conditions affect them. At nanoscopic sizes, the surface energy contributes significantly to the total energy of the particle, and as a consequence, the surface of a nanoparticle largely determines its properties. It is thus essential to investigate various types of surface modifying processes, for instance optical in-flight annealing. Transmission electron microscopy was used in combination with magnetic measurements to determine the atomic structure, chemical composition and magnetic behavior of the particles. It is found that surface modifications cause large differences in the crystallinity and saturation magnetization of these RE-TM nanoparticles.