Tailor-Made Nano Structured Magnetic Materials for Highly Advanced Spin Related Devices

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Abstract

An understanding modern magnetic material cannot be achieved without fundamental knowledge of intrinsic magnetic properties such as magnetization, magnetic anisotropy, magnetostriction, because technical magnetizaition is dominated through these magnetic properties as well as metallurgical phase. The most advanced developments in magnetic recording, or in permanent magnets, are based on nano-scaled precise control of microstructure intended to attain required properties. So the improvement has been achieved by tailoring magnetic interaction among grains and/or layer to layer and the microstructure of magnetic materials with sophisticated production process.

This presentation covers the physics of magnetic materials and the technology for controlling the magnetic properties from soft magnetic materials to hard magnetic materials widely. Initially, typical technological development and fundamental knowledge of intrinsic magnetic properties will be briefly reviewed and then the following topics will be discussed:

(1) Hard magnetic materials (Permanent magnet)
(2) Semi-hard materials (Magnetic recording media)
(3) Soft magnetic materials (Inductor core etc.)
(4) Exchange bias materials (Spintronics devices)
(5) Magnetic nanoparticle assembly.

Keywords: Permanent magnet, Magnetic recording media, Exchange bias materials, Magnetic nanoparticle , Magnetic anistropy

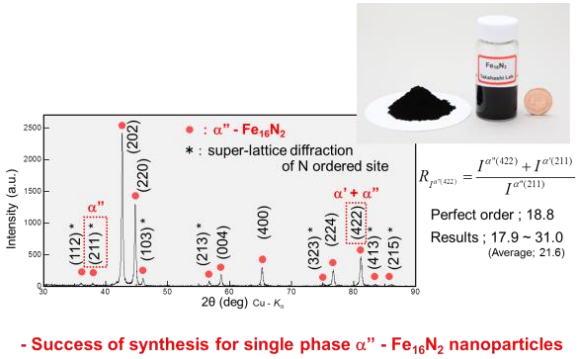

Fig.1 XRD profiles for α"-$Fe_{16}N_2$ nanoparticles

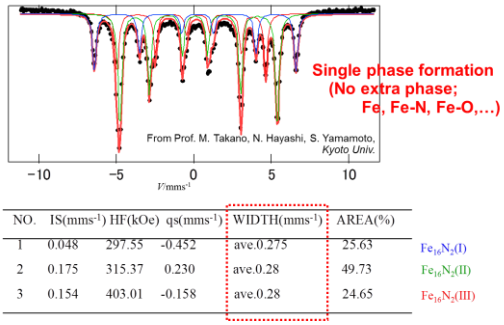

Fig.2 Mössbauer spectra of α"-$Fe_{16}N_2$ nanoparticles

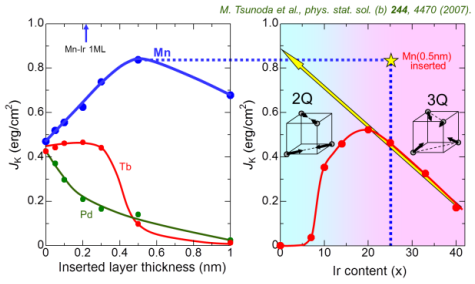

Fig.3 Insertion effect of ultra-thin Mn on J_K

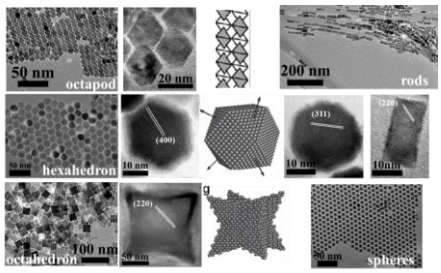

Fig.4 Shape-controlled Fe_3O_4 nanostructures

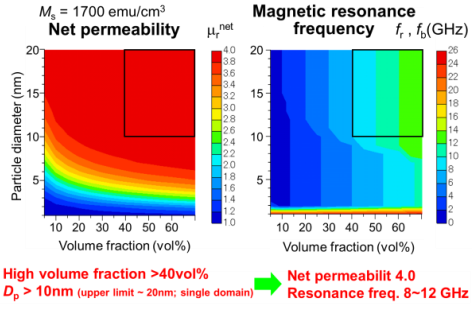

Fig.5 Net permeability and magnetic resonance frequency for Fe NP assembly with high volume fraction