FePt Loaded Nanostructured Silicon as High Energy Product Composite

Klemens Rumpf[1], Petra Granitzer[1], Roberto Gonzalez-Rodriguez[2], Jeffery Coffer[3]

[1]*Institute of Physics, University of Graz, 8010 Graz, Austria*
[2] *Department of Physics, University of North Texas, Denton, TX, 76203, USA*
[3] *Department of Chemistry, Texas Christian University, Fort Worth, TX, USA*

Corresponding author email: klemens.rumpf@uni-graz.att

In this work nanostructured silicon, silicon nanotubes (SiNTs) and porous silicon (PSi), with embedded hard magnetic FePt nanoparticles (NPs) is used as platform to create nanomagnetic arrays. The magnetic response of FePt-loaded composite materials is investigated, which have potential in high-performance magnets and as rare earth magnet alternatives. Face-centered cubic (fcc) FePt particles generally show a superparamagnetic or soft magnetic behavior depending on the size. Face-centered tetragonal (fct) FePt particles offer high uniaxial magnetocrystalline anisotropy with hard magnetic behavior. The aim is to fabricate hard magnetic FePt particles within nanostructured silicon. For comparison Co nanoparticles (NPs) are grown inside the nanostructured silicon templates. The PSi samples offer a mesoporous morphology with oriented and separated pores. The SiNTs were produced by using arrays of ZnO nanowires (NWs) as template, followed by Si deposition and finally etching off the ZnO NWs which allows to tune the inner diameter as well as the wall thickness. FePt nanocrystals were electroless grown within SiNTs and PSi by a multistep process. Magnetization measurements were carried out by a VSM in recording the magnetic response dependent on the magnetic field. Samples with different Fe content (Pt:Fe = 1:1, 1:3, 1:6) are investigated with respect to their magnetic response for both types of matrices (SiNTs, PSi). Furthermore the investigations show that the coercivities of PSi loaded with FePt NPs are about twice the coecivities of SiNTs loaded with FePt NPs. From the investigated composite systems, the ones consisting of PSi and FePt offer the highest energy product.