Nanotek-2013

OMICS Group Conferences
Accelerating Scientific Discovery

3rd International Conference on
Nanotek & Expo

December 2-4, 2013 Las Vegas, USA

Structure – property relations in high anisotropy nanomagnets

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Abstract

Due to their large potential for a variety of applications, metallic nanomagnets have attracted considerable attention in the last decades. Among those, nanoparticles with very high magnetic anisotropies are particularly interesting as active materials for future ultra-high density magnetic data storage applications. Here, intermetallic alloys of the chemically ordered $L1_0$ phase such as $L1_0$-FePt are considered as one of the most promising materials candidates, as they combine magnetic hardness with a high resistivity against oxidation.

In this talk,some of our recent work on the correlation between the atomically resolved structure of such FePt nanoparticlesand their magnetic properties will be presented. The investigated materials range from particles that are prepared by inert gas condensation and subsequent in-flight rapid thermal annealing to sputtered thin particulate FePt-X films for future heat assisted magnetic recording (HAMR, films provided by *HGST – A Western Digital Company*).

The gas-phase prepared $L1_0$-FePt nanomagnets are found to exhibit relatively low coercive fields and switching field distributions (SFD's) that are limited to the range 0 T $<M_0H_{sw}<$2 T. Remanence analyses reveal that the magnetic anisotropy of these particles is size dependent, which is due to a (partial) segregation of Pt towards the particle surface as evidenced from aberration-corrected HRTEM and MD simulations. In contrast, the SFD of the particulate FePt-X films peaks at fields as high as μ_0H_{sw} 6 Tand the $L1_0$-ordered FePt particles are highly textured due to their growth on a MgO seed layer at elevated temperatures [1]. The influence of (i) a certain discrepancy between a remaining misorientation of the crystallographic [001] axes of the FePtnanomagnets and the magnetic texture width as determined from the hard axis remanence of the particulate film and (ii) the presence of thermally instable particles on the overall magnetic performance will be discussed.

Biography

Bernd Rellinghaus has earned his PhD in physics from the University of Duisburg, Germany. Awarded with a Research Stipend of the German Science Foundation hethen joined the IBM Almaden Research Center in San Jose, CA, USA. In 1997 he returned to Duisburg and moved to Dresden, Germany, in 2004, where he since then heads the Department for Metastable and Nanostructured Materials at the Leibniz Institute for Solid State and Materials Research (IFW Dresden). Bernd Rellinghaus is an expert in metallic materials, nanoparticles(particularly in nanomagnets)and in high resolution transmission electron microscopy. He has published about100 papers in reputed journals.