Magnetic properties of the submicron-sized particles with different geometries

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Magnetic submicron particles with different geometries such as triangular elements, rings, and rods arranged in large ordered arrays (several cm^2), were fabricated using a new kind of nanosphere lithography (NSL). These various geometries constitute interesting systems for the study of the micromagnetic configuration and to future possible technological applications.

Fundamentally, the reduction of the dimensions of ferromagnetic structures up to the sub-micrometre regime leads to a decrease in size of the magnetic domains and the domain wall width as well as to a change in size of the spin and orbital momentum and the magnetic anisotropy. Consequently, the magnetic properties of submicron elements undergo drastic changes and their micromagnetic configurations become simplified comparing to their bulk counterparts. Their magnetic ordering, in particular depends sensitively on the element size, thickness, and on the exact shape.

The structural and magnetical properties of three different geometries have been investigated by means of magnetic force microscopy (MFM). In triangular elements, rods and rings, the magnetic contrasts show the reduction of the magnetic configuration to three, two and one possible magnetic domain state, respectively. These experimental results were then compared to micromagnetic simulations performed using the Object Oriented Micromagnetic Framework (OOMMF) [Fig. 1].

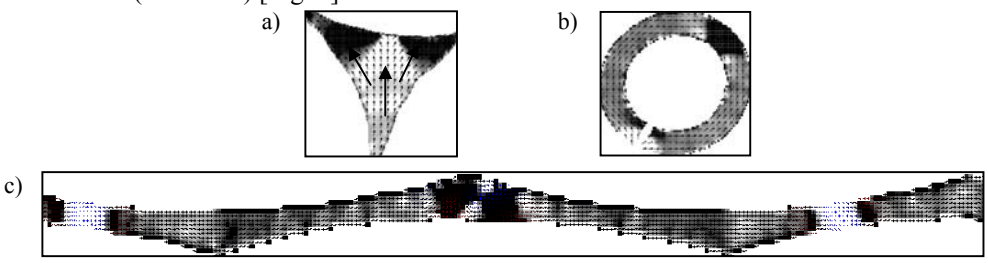

Fig. 1. The hypothetical OOMMF-simulated contrast for a triangular element (a) where the quasi single domain Y-state is calculated ring (b) at onion state, rod (c)with vortex and multidomain structure.

The detailed magnetic investigations were carried out by means of vibrating sample magnetometer (VSM), superconducting interference device (SQUID) and X-ray magnetic circular dichroism combined with photoemission electron microscopy (XMCD-PEEM). Results are presented for Ni and Co triangles as a function of lateral sizes and thickness.

[1] A. Kosiorek, W. Kandulski, P. Chudzinski, K. Kempa, and M. Giersig, Nano Letters, **4** (2004) 1359
[2] A. Kosiorek , W. Kandulski, H. Glaczynska , M. Giersig; Small **1** (2005) 439

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