Reversal of Flux Closure States in Cobalt Nanoparticle Rings With Coaxial Magnetic Pulses

Jie Liu[a], Takeshi Kasama[b], Rafal E. Dunin-Borkowski[c], Michael R. Scheinfein[d], Steven L. Tripp[e], Alexander Wei[a]

Thermoremanent Co nanoparticles (25-30 nm) were synthesized by the thermal decomposition of $Co_2(CO)_8$ in the presence of calixarene-derived surfactants[1]. They self-assemble into ring structures comprising 5-11 particles when dispersed in a toluene solution with C11 resorcinarene as surfactant. Electron holography reveals that these Co nanoparticle rings support well-defined flux closure (FC) states with clockwise (CW) and counterclockwise (CCW) polarization at room temperature[2]. The FC polarizations can be switched upon applying coaxial magnetic pulses (Hz) in alternating directions. Micro-magnetics simulation of the novel FC switching mechanism has been conducted, revealing a metastable "double-vortex" domain structure at intermediate field strengths[3]. Larger (macrocyclic) nanoparticle rings also have FC states that can be switched by Hz pulses, but can support an intermediate dipolar ("onion") state as well.

---

[1] S. L. Tripp, S. V. Pusztay, A. E. Ribbe, A. Wei, J. Am. Chem. Soc. 2002, 124, 7914 and unpublished results.

[2] S. L. Tripp, R. E. Dunin-Borkowski, A. Wei, Angew. Chem. Int. Ed. 2003, 42, 5591.

[3] T. Kasama, R. E. Dunin-Borkowski, M. R. Scheinfein, S. L. Tripp, J. Liu, A. Wei, Adv. Mater. 2008, in press (10.1002/adma.200702941).