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Mesoscopic Conductance Fluctuations in Cobalt Nanoparticles
YAGUANG WEI, XIYA LIU, LIYUAN ZHANG, DRAGOMIR DAVIDOVIC, Georgia Institute of technology, SCHOOL OF PHYSICS, GEORGIA INSTITUTE OF TECHNOLOGY TEAM — We present measurements of mesoscopic conductance fluctuations in Cobalt particles of diameter 200nm. Samples are made by e-beam lithography and shadow metal deposition. Co particles are not single domain; domain walls are nucleated at the contacts between Co and Cu-reservoirs. We obtain the dependence of peaks in differential resistance with the applied voltage and the magnetic field during the magnetization reversal process at 0.03K temperature. The conductance fluctuations with the magnetic field are caused by a mechanism different from the usual Aharonov-ohm effect. In particular, domain walls are found to generate significant mesoscopic fluctuations. We obtain that electron transfer across the domain wall is associated with a phase change of about 5π. We explain how this phase-shift arises from a not perfectly parallel spin-transport across domain walls. The dephasing time is very short, $\tau_\phi \sim ps$. Fast dephasing is correlated with the strong magnetocrystalline anisotropy in Co. This work was performed in part at the Georgia-Tech electron microscopy facility. We thank P. Brouwer for valuable discussions. This research is supported by the David and Lucile Packard Foundation grant 2000-13874 and Nanoscience/Nanoengineering Research Program at Georgia-Tech.

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