Size-dependent spin structures in supported iron nanoparticles

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Nanoscale magnets exhibit a variety of unusual phenomena when compared to respective bulk materials, particularly when the dimensions involved are comparable to critical magnetic length scales such as the exchange length. Below a critical size, the formation of domain walls is suppressed and the nanostructures are uniformly magnetized, i.e. in a single domain state. Using photoemission electron microscopy, we study the magnetization orientation in single 5 to 25 nm iron particles coupled to a ferromagnetic cobalt support. We find a non-collinear alignment between the particle and substrate magnetization above about 6 nm and a parallel alignment for smaller sizes. Numerical calculations reveal an exchange- to anisotropy-dominated transition on increasing the particle height: the smaller particles are in a single-domain collinear state while larger particles exhibit a spin-spiral magnetic structure determined by the magnetic anisotropy energy.

References

A. Fraile Rodríguez, A. Kleibert, J. Bansmann, A. Voitkans, L. J. Heyderman, and F. Nolting. *Size-Dependent Spin Structures in Iron Nanoparticles*. Phys. Rev. Lett. **104**, 127201 (2010).

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