MAGNETIC PROPERTIES OF 2D NANO ISLANDS SUBJECT TO TRANSVERSE MAGNETIC FIELDS: EFT ISING MODEL

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9.7 cm

An Ising spin effective field theory (EFT) is presented to calculate the magnetic properties of 2D nano islands on nonmagnetic substrates, subject to an applied in plane magnetic field. The system Hamiltonian contains nearest neighbor exchange interactions, single-atom magnetic anisotropies, and the transverse field, with a system model spin $S = 1$ that permits the analysis of local spin fluctuations. An *exact* EFT symbolic and numerical approach is developed for the first time to avoid approximations inherent to previous analytical treatments to diagonalize the non-diagonal Hamiltonian. Furthermore, the applicability of this exact formulation has been extended successfully to higher spin values. Our calculations yield the single site spin correlations, the magnetizations, and the isothermal susceptibilities for the nano island core and periphery domains. We investigate the effects due to the remarkably different domain anisotropies over their reduced dimensionalities, and in particular the critical influence of the applied magnetic field. Detailed theoretical results are presented for the honeycomb, square and hexagonal lattices, with numerical applications for well known mono-layer Co nano islands. The remarkable differences between the core and periphery properties in zero fields are strongly modified. In particular the applied field provokes critical discontinuities at very small temperatures for the spin correlations and magnetizations.

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