

FOURTH ORDER PERTURBED HEISENBERG HAMILTONIAN OF BCC STRUCTURED FERROMAGNETIC THIN FILMS WITH THREE SPIN LAYERS

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Abstract

The solution of fourth order perturbed Heisenberg Hamiltonian of bcc structured ferromagnetic ultra-thin films with three spin layers with all seven magnetic energy parameters were investigated. All the magnetic energy parameters such as spin exchange interaction, magnetic dipole interaction, second order and fourth order magnetic anisotropy constants, in plane and out plane applied magnetic fields, demagnetization factor and stress induced anisotropy were included in the fourth order perturbed Heisenberg Hamiltonian. 3D plot of total magnetic energy versus angle and stress induced anisotropy were plotted for different values of second order magnetic anisotropy constants. All other magnetic energy parameters were fixed at constant values. All the peaks are closely packed in the graphs plotted using fourth order perturbed Heisenberg Hamiltonian compared to peaks in the graphs plotted using second and third order perturbed Heisenberg Hamiltonian. The order of magnetic energy was changed when the values of second order anisotropy constants of three spin layers are varied. The magnetic energy is higher, when the values of second order magnetic anisotropy constant in the top spin layer is less than those of the bottom and middle spin layers. The order of magnetic energy is lower, when the values of second order magnetic anisotropy constant in the middle spin layer is less than those of the top and bottom spin layers. In addition, the angle between consecutive magnetic easy and hard direction is nearly 90 degrees for all the cases.

Keywords: *fourth order perturbed Heisenberg Hamiltonian, magnetic anisotropy constant, magnetic thin films, spin, stress induced anisotropy*