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Transition Temperature of Ultra Thin Magnetic films

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The magnetic properties in the Ising ferromagnetic thin films are studied by transfer matrix method. The transition temperatures are calculated as a function of the intra- and interlayer exchange interactions. The results show that the transition temperature changes with the thickness of film. The main focus of this investigation is to study the Curie temperature based on the mean field theory and transfer matrix method in a thin film that it is assumed as atomic mono layers. In this paper, we have completed the theoretical work of Ref. [1]. We have studied the transition temperature of Ising magnetic films in SC (001), FCC (111), FCC (001) and BCC (111) structures. The coordination number is defined as: $z = z_0+z_1$, that it is different for various structures. For example, the face-centered cubic with (111) (namely FCC (111)) and (001) (namely FCC(001)) structures, the coordination numbers are ($z_0 = 6$, $z_1 = 3$) and ($z_0 = 4$, $z_1 = 4$), respectively; a body-centered cubic lattice with (111) structure (namely BCC (111)), $z_0 = 6$, $z = 1$; and for simple cubic lattice, we have $z_0 = 4$, $z = 1$. In order to illustrate the influence of the lattice structure types, we analyze the dependence of the reduced critical temperature as a function thin thickness N. Calculations show that critical temperatures T_C in thin films with various structures changes with increasing numbers of layers. The transition temperatures strongly depend on the coordination number in various structures.

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Atomistic simulation on temperature dependence of exchange bias

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Exchange bias phenomenon has attracted considerable interestsdue to its widespread use in magnetic data storage device since it was discovered half a century ago [1, 2, 3]. The interfacial effect plays a central role in understanding the exchange bias effect of ferrogmagnet (FM)-antiferromagnet (AFM) bi-layer structures.

We studied the temperature dependence of the exchange bias field HEB and coercive field HC in FM/FeF2 bilayers with a mixing interface by using Monte Carlo method. The Heisenberg model was used to describe the microstructure of system. The simulations show that the HEB and HC are dependent strongly on the mixing coefficients R, i.e., the ratio of FM atoms to AFM atoms at the interface, as well as temperature. The microstructure with the roughest interface, i.e., R=0.5, gives a largest HEB but smallest H_C below a certain temperature. The HC shows a bump at the Néel temperature, which is very similar to a recent experiment [4]. When the mixing coefficient equals zero, i.e., the interface layer consists of only AFM atoms, the positive exchange bias can occur as a result of the antiparallel coupling between FM and interfacial uncompensated AFM spins [1]. In addition, dependences of exchange bias and coercive field on the AFM thickness are also studied for various mixing coefficients, and it is found that the coercive field decreases as the thickness of AFM film increases.

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