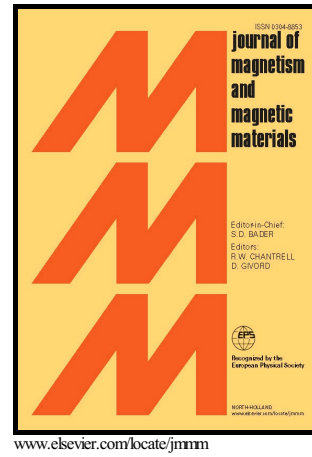


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Mixed spin (1/2,1) transverse Ising nanoparticles

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Abstract

Mixed spin 2D-nanoparticles (circle and square) described by the transverse Ising model are investigated by the use of the finite cluster approximation. The effects of the exchange interactions and the transverse field parameters on the phase diagrams are systematically discussed, in particular, it was shown that the transition temperature is not so sensitive to shell exchange interaction, when the spins S are strongly correlated. A number of interesting phenomena have been found such as reentrant behavior. This latter, which is due to the competition between the exchange interaction and core-transverse field, disappears completely for any no-zero shell transverse field.

Keywords: mixed spin, circle and square 2D-nanoparticle, Transverse Ising model, Finite cluster approximation, Phase diagrams.

1. Introduction

During the last few years, research on magnetic nanomaterials such as nanoparticles, nanorods, nanobelts, nanowires and nanotubes, has been attracting considerable attention, and is considered the most actively studied topic in statistical mechanics and condensed matter physics. This is due to their promising applications in nanotechnology [1,2] such as permanent magnets [3], information storage devices [4,5], biosensors [6] and some medical applications [7]. At present, the scientist can produce such kinds of fine nanoscaled materials [8,9], and the magnetization of certain nanomaterials such as γ -Fe₂O₃ nanoparticles has been experimentally measured [10]. In particular, magnetic nanowires and nanotubes such as ZnO [11], FePt, and Fe₃O₄ [12] can be synthesized by various experimental techniques and they have many application in nanotechnology [13,14]. They are also utilized as raw materials in fabrication of ultra-high density magnetic recording media [15-17]. On the other hand, the

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