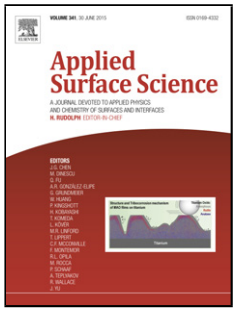

Title: Surface behavior of magnetic phase transitions: Monte Carlo Study

Authors: R. Masrour, A. Jabar

PII: S0169-4332(17)32395-4
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2017.08.063
Reference: APSUSC 36900

To appear in: *APSUSC*

Received date: 11-9-2016
Revised date: 6-8-2017
Accepted date: 7-8-2017

Please cite this article as: R.Masrour, A.Jabar, Surface behavior of magnetic phase transitions: Monte Carlo Study, Applied Surface Sciencehttp://dx.doi.org/10.1016/j.apsusc.2017.08.063

<AT>Surface behavior of magnetic phase transitions: Monte Carlo Study
<AU>R. Masrour* ##Email##rachidmasrour@hotmail.com##/Email##, A. Jabar
<AFF>Laboratory of Materials, Processes, Environment and Quality, Cady Ayyed University, National School of Applied Sciences, PB 63 46000, Safi, Morocco
<ABS-HEAD>Highlights► • The magnetic properties of superlattice with simple cubic lattice formed by mixed spins-5/2 and 2 in has been studied. ► •The transition temperature of mixed spins has been obtained using Monte Carlo simulation. ► •The ground state and magnetic phase diagrams have been obtained. ► •The multiphase points and multiples of hysteresis cycles have been presented.

<ABS-HEAD>Abstract

<ABS-P>In this manuscript, we have studied the magnetic properties of superlattice with simple cubic lattice formed by mixed spin-5/2 in surface and spin-2 in bulk using the Monte Carlo simulations. The ground state of this system is given. The critical temperature has been deduced and discussed. The thermal behaviors of the magnetizations as well as the effect of the different exchange interactions and the crystal field effect, have also been studied. The magnetic hysteresis cycles of such system has been discussed for different values of the exchange interactions between superlattice, for different values of the crystal field and for different temperature values. The effects of the crystal fields, temperatures and the increase in the number of interactions induce greater complexity in the phase diagrams, causing various multiphase points and multiples of hysteresis cycles and allow exploring regions where important magnetic behaviors could arise.

<KWD>Keywords: Superlattice; Ising model; Monte Carlo simulations; Critical temperature;

Surface and bulk science.

<KWD>PACS: 61.46.-w; 75.60.-d; 75.60.Ej; 71.45.Gm.

<H1>1. Introduction

Recently, magnetic materials with finite sizes such as thin films have attracted considerable amount of interest both in theoretical [1-6] and experimental manner and the research of thin film magnetism is a current topic of critical phenomena [7–10]. A several studies using different methodologies such as the mean field theory, Monte Carlo simulations and high temperatures series expansions have been used to study the magnetic properties of thin film[11-17]. Theoretically the physics of these phenomena has been investigated using well known techniques in equilibrium statistical mechanics, such as series-extrapolation technique [18], renormalization group calculations [19], cluster variation method [20,21], Monte-Carlo simulation [22], high temperatures series expansions [23] and effective field-theory [24]. Subsequent studies using different methodologies focused on the question of how the shape and area of hysteresis loops depend on the period and amplitude of the magnetic field [25-27]. On other hand, the Glauber-type stochastic dynamics is also used to study the spin-2 Ising model with the ferromagnetic/ferromagnetic (FM/FM), antiferromagnetic/ferromagnetic (AFM/FM) and AFM/AFM interactions on the two-layer square lattice [28]. In addition to the fundamental purpose, thin film materials have great importance in technological applications [29-33]. For instance, ultrathin Au/Co/Au magnetic films, CoPt-alloy films, CoNi/Pt and Tb/Fe multilayers are considered as potential candidates of raw materials in ultrahigh-density