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# Dynamic hysteresis behaviors for the two-dimensional mixed spin (2, 5/2) ferrimagnetic Ising model in an oscillating magnetic field

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ABSTRACT

Keskin and Ertaş (2009) presented a study of the magnetic properties of a mixed spin (2, 5/2) ferrimagnetic Ising model within an oscillating magnetic field. They employed dynamic mean-field calculations to find the dynamic phase transition temperatures, the dynamic compensation points of the model and to present the dynamic phase diagrams. In this work, we extend the study and investigate the dynamic hysteresis behaviors for the two-dimensional (2D) mixed spin (2, 5/2) ferrimagnetic Ising model on a hexagonal lattice in an oscillating magnetic field within the framework of dynamic mean-field calculations. The dynamic hysteresis curves are obtained for both the ferromagnetic and antiferromagnetic interactions and the effects of the Hamiltonian parameters on the dynamic hysteresis behaviors are discussed in detail. The thermal behaviors of the coercivity and remanent magnetizations are also investigated. The results are compared with some theoretical and experimental works and a qualitatively good agreement is found. Finally, the dynamic phase diagrams depending on the frequency of an oscillating magnetic field in the plane of the reduced temperature versus magnetic field amplitude is examined and it is found that the dynamic phase diagrams display richer dynamic critical behavior for higher values of frequency than for lower values.



## 1. Introduction

Keskin and Ertaş [1] presented a study of the magnetic properties of a mixed spin (2, 5/2) ferrimagnetic Ising model within an oscillating magnetic field. They presented both the dynamic compensation point of the model and dynamic phase diagrams. This work is important due to the reason that it deals with ferrimagnetisms as well as with the compensation temperature. The phenomenon of ferrimagnetism has been one of the intensively studied subjects in condensed matter physics and statistical mechanics, because of their potential device applications in technologically important materials [2]. Moreover, the mixed spin (2, 5/2) Ising system is the prototypical system that has been used for studying the magnetic behaviors of molecular-based magnetic materials, such as $AFe^{II}Fe^{III}(C_2O_4)_3$ [$A = N(n{-}CnH_{2n+1})_4$, $n = 3$–5] [3–12]. Therefore, the purpose of this paper is to extend the work of Ref. [1], i.e. the study of the dynamic compensation temperature of a mixed spin (2, 5/2) Ising ferrimagnetic system on a hexagonal lattice. In particular, the dynamic hysteresis behaviors of two-dimensional (2D) mixed spin (2, 5/2) ferrimagnetic Ising model are investigated for on a hexagonal lattice in an oscillating magnetic field within the framework of dynamic mean-field calculations. The dynamic hysteresis curves are obtained

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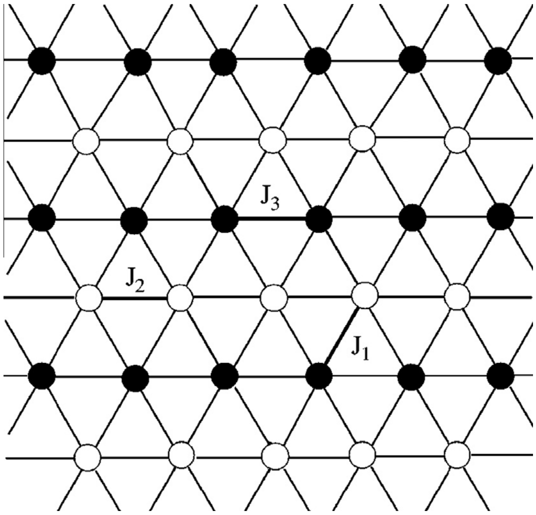


**Fig. 1.** The sketch of the spin arrangement on the hexagonal lattice. The lattice is formed by alternate layers of $\sigma$ (open circles) and $S$ (solid circles) spins.

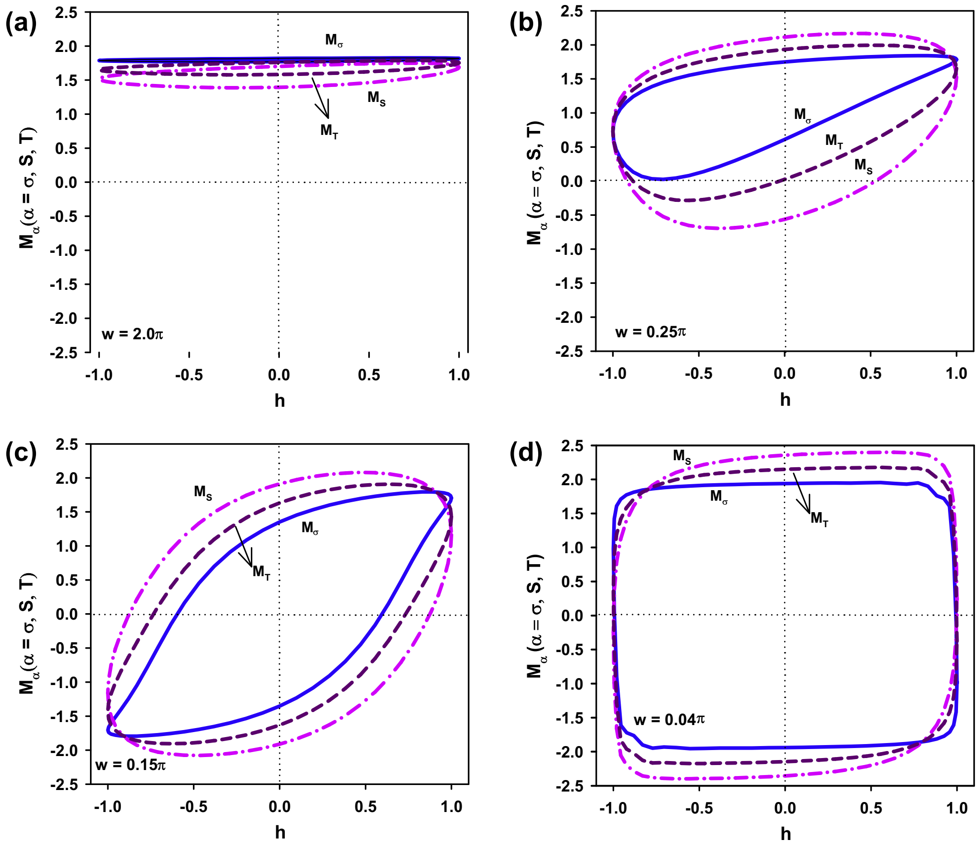


**Fig. 2.** The dynamic hysteresis behaviors for the ferromagnetic interaction, $J_1$ = 0.1, $J_2$ = 0.5, $J_3$ = 0.1, $T$ = 2.1, $d$ = 1.0, (a) $w$ = 2.0π, (b) 0.25π, (c) 0.15π, (d) 0.04π.

for both the ferromagnetic and antiferromagnetic interactions, and the effects of the Hamiltonian parameters on the dynamic hysteresis behaviors are discussed in detail. The thermal behaviors of the coercivity and remanent magnetizations are also investigated. Finally, the dynamic phase diagrams depending on the frequency of an oscillating magnetic field are investigated in the plane of the reduced temperature versus magnetic field.