Effective-Field Theory of the Ising model with three alternative layers on the honeycomb and square lattices

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The magnetic properties of the thin films have been intensely studied both experimentally and theoretically due to the important practical applications and as well as fundamental researches for four decades. Especially, bilayer systems have been investigated in detail so far. On the other hand, a considerable research interest has been devoted to study the physical properties of the trilayers systems both experimentally and theoretically in recent years. While much work has been done on trilayers systems experimentally \cite{1}, there have been relatively few investigations devoted to study trilayer systems theoretically \cite{2}. In this work, the Ising model with three alternative layers on the honeycomb and square lattices is studied by using the effective-field theory (EFT) with correlations. We consider that the nearest-neighbor spins of each layer are coupled ferromagnetically and the adjacent spins of the nearest-neighbor layers are coupled either ferromagnetically or antiferromagnetically depending on the sign of the bilinear exchange interactions. We investigate the thermal variations of the magnetizations and present the phase diagrams. The phase diagrams contain the paramagnetic, ferromagnetic and anti-ferromagnetic phases and the system also exhibits a tricritical behavior.


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