MAGNETIC PROPERTIES OF THE SUPER-EXCHANGE ANTIFERROMAGNETIC ISING PLANAR MODEL WITH THE UNIAXIAL CRYSTAL-FIELD ANISOTROPY

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9.7 cm

Fisher super-exchange antiferromagnetic model is generalized by adding the uniaxial crystal-field anisotropy on decorated atoms with an arbitrary spin S. We consider the square lattice in which the antiferromagnetic arrangment of spin-S atoms is realized via intermediate nonmagnetic atom. Using an extended mapping technique we obtain the exact relation between partition function of studied system and that one of the standard zero-field spin-1/2 Ising model on the square lattice. Although, we are able to obtain exact results for all relevant physical qauntities, here we mainly focus on the investigation of ground-state and finite-temperature phase diagrams for the system with spin-3/2 decorating atoms. In this system one finds six different phases at $T = 0$, namely two antiferromagnetic, two ferrimagnetic and two paramagnetic phases. For $T > 0$ the antiferromagnetic and ferrimagnetic phases merge into one ordered phase with nonzero staggered magnetization. Next, after crossing a critical temperature the second-order phase transition into paramagnetic state is observed. Our results are compared with those of the spin $S = 1/2$ and $S = 1$ models.

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