Exact solution for the spin-chain model of alternating Ising and Heisenberg spins in arbitrary magnetic field
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The spin-chain model of alternating Ising and Heisenberg spins in arbitrary magnetic field is exactly solved by making use of the transfer-matrix method. The proposed model brings a deeper insight into the ferrimagnetism of bimetallic spin chains, which constitute two different but regularly alternating magnetic ions with unequal Landé factors. It is demonstrated that the low-temperature magnetization process depends basically on a spatial orientation of the applied magnetic field with respect to the easy-axis direction of the Ising spins. The sharp stepwise magnetization curve, which is characteristic for the magnetic field applied along the easy-axis direction of the Ising spins, becomes gradually smoother if the external field is tilted from the easy-axis direction of the Ising spins. The angular dependence of the low-temperature magnetization curve of a single-crystal sample is investigated in particular. In addition, the low-temperature magnetization curve for a polycrystalline sample is also exactly calculated by performing the powder averaging of the derived magnetization formulae. The presented theoretical results shed light on the high-field magnetization curve of 3d-4f bimetallic chain \([\text{Dy(NO}_3\text{)}_2\text{DMSO}_2\text{Cu(opba)}\text{DMSO}_2]\), which can be regarded as the experimental representative of the spin-chain model of alternating Ising and Heisenberg spins formed by the highly anisotropic dysprosium(3+) and almost isotropic copper(2+) ions.

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