Simple model of magnetization processes in rare-earth tetraborides

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We present a simple model for a description of magnetization processes in rare-earth tetraborides. The model is based on the coexistence of two subsystems, and namely, the spin subsystem described by the Ising model and the electronic subsystem described by the Falicov-Kimball model on the Shastry-Sutherland lattice (SSL). Moreover, both subsystems are coupled by the anisotropic spin-dependent interaction of the Ising type. We have found, that the switching on of the spin-dependent interaction (J_z) between the electron and spin subsystems and taking into account the electron hopping on the nearest (t) and next-nearest (t') lattice sites of the SSL leads to a stabilization of new magnetization plateaus. Besides the the Ising magnetization plateau at $m^{sp}/m_s^{sp} = 1/3$ we have found three new relevant magnetization plateaus located at $m^{sp}/m_s^{sp} = 1/2$, $1/5$ and $1/7$ of the saturated spin magnetization m_s^{sp}. The ground-states corresponding to magnetization plateaus have the same spin structure consisting of parallel antiferromagnetic bands separated by ferromagnetic stripes. In addition, the transitions from the low temperature ordered phase to the high-temperature disordered phase are analyzed by the canonical Monte-Carlo method.