Magnetic anisotropy of frustrated Shastry-Sutherland metallic systems TmB_4 and ErB_4

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Geometrically frustrated lattices play an important role in emergent quantum mechanical phases, which have been rather well investigated in the case of electronic insulators. However, recently a variety of interesting frustration effects appeared also in metallic systems. A system that exhibits both lattice frustration and metallic behaviour are the rare-earth (*RE*) tetraborides REB$_4$ [1-4]. They have a tetragonal structure with magnetic *RE* ions embedded in boron network and forming a lattice topologically equivalent to the frustrated Shastry-Sutherland lattice (SSL) in the *ab* plane. While the 4*f* electrons of *RE* ions are localized in frustration positions, the 5*d* electrons from *RE* and 2*p* from B ions act as free / itinerant carriers. A particularly interesting situation appears with trivalent *RE* = Er and Tm, where a strong Ising single-ion anisotropy causes that the *f* -electron moments may be described within up/down twofold degree of freedom locked / oriented perpendicular to the frustrated SSL plane and in which magnetization plateau transitions arise from complex spin-flip processes.

In our contribution we compare the anisotropic behaviour of TmB_4 and ErB_4 and by investigating the angular dependencies of their thermal and magnetic properties in a wide range of temperatures (*T*) and magnetic fields (*H*). Based on them *H* - *T* phase diagrams of TmB_4 and ErB_4 as function of the angle between the *ab* (SSL) plane and *H* have been for the first time constructed. Compared are also the rotating magneto-caloric effects (R-MCE) of both compounds. Spin-electron model was suggested to explain the complex behaviour of R-MCE, which is based on the idea of two interacting systems: the localized spins of *RE* ions and the itinerant electrons in conduction band [5]. The received results from Monte Carlo approach successfully reproduce the observed heating and cooling regions in *H* - *T* phase diagrams of TmB_4. Thus, our study shows that measurements of R-MCE can be an effective tool for investigating the microscopic properties of magnetization processes.

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