Weak ferrimagnets with competing Dzyaloshinskii-Moriya coupling are perspective for the exchange-bias effect materials.

Alexander Moskvin[1]

[1]Ural Federal University, Ekaterinburg, Russia

The exchange bias (EB) effect, that is a shift in magnetization hysteresis loop from the origin, is at present a key instrument for practical applications in magnetic memory and spintronics. The EB effect tuned by applied magnetic field and temperature has been recently observed in some ferrimagnets (FIMs) exhibiting the magnetization reversal (MR) and negative magnetization. Here I would like to draw attention to so-called weak ferrimagnets (WFIMs), or mixed compounds with competing Dzyaloshinskii-Moriya (DM) coupling $V_{DM} = \sum_{i>j}(\vec{d}_{ij} \cdot [\vec{S}_i \times \vec{S}_j])$, strictly speaking with different signs of the Dzyaloshinskii vector $\vec{d}_{ij}$. For so-called S-type 3d-ions given the same superexchange geometry these are presented here in Table [1]. According to theoretical predictions d_{FeFe} and d_{CrCr} have the same sign, however, this is opposite to the sign of the d_{FeCr} vector. Competition of Fe-Fe, Cr-Cr, and Fe-Cr DM coupling with antiparallel orientation of the mean weak ferromagnetic moments of the Fe and Cr subsystems in a wide concentration range points to a weak ferrimagnetic behavior with the temperature compensation points. For the first time the unconventional concentration and temperature behavior of magnetization with compensation effects in single-crystalline mixed orthoferrite-orthochromites $YFe_{1-x}Cr_xO_3$ (x= 0.05; 0.15; 0.20; 0.38; 0.50; 0.65; 0.85; 0.95) has been observed and explained by Kadomtseva et al. forty years ago**,** in 1977 [2]. The unusual behavior of these compounds was explained within molecular field approximation (MFA) with account of the isotropic antiferromagnetic superexchange and competing antisymmetric DM couplings [1]. Due to theoretical predictions [1] ferrites-chromites $RFe_{1-x}Cr_xO_3$ (R – rare-earth or Y), $Fe_{1-x}Cr_xBO_3$, and $Fe_{2-x}Cr_xO_3$, as well as carbonates $Mn_{1-x}Ni_xCO_3$ with competition of d^5-d^5, d^5-d^8, and d^8-d^8 DM couplings are believed to be perspective compounds for the exchange-bias effect materials. In the talk I present an overview of experimental data available, theoretical background and prediction of the magnetic behavior for weak ferrimagnets to be a novel class of perspective magnetic materials.

	d^3	d^5	d^8
d^3	+	–	+
d^5	–	+	+
d^8	+	+	–

The work supported by Act 211 Government of the Russian Federation, agreement # 02.A03.21.0006 and by the Ministry of Education and Science, projects 2277 and 5719.

[1] A.S. Moskvin and I.G. Bostrem, Sov. Phys. Solid State 19, 1532 (1977); A.S. Moskvin, JMMM, **400**, 117 (2016).

[2] A.M. Kadomtseva, A.S. Moskvin, I.G. Bostrem, B.M. Wanklyn, and N.A. Khafizova, Sov. Phys. JETP **72**, 2286 (1977).