Functionalization of Er^{3+} single-ion magnet using ferromagnetic microparticles

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Single-ion magnets (SIM–single ion magnets) are promising objects for the development of platforms for quantum computing and information storage [1]. In SIM, relaxation occurs rather quickly, so it cannot be measured with a SQUID magnetometer and does not correspond to the conditions of quantum decoherence required for quantum calculations. The solution to this problem is the application of an external magnetic field (electromagnet), which shifts the relaxation time to the desired frequency range. In our work, we propose to use the residual field of a ferromagnetic particle to create an external field. The use of PrDyFeCoB ferromagnetic microparticles with a predetermined magnetization that is retained makes it possible to control the local rate of spin relaxation in complexes covering microparticles (Fig. 1).

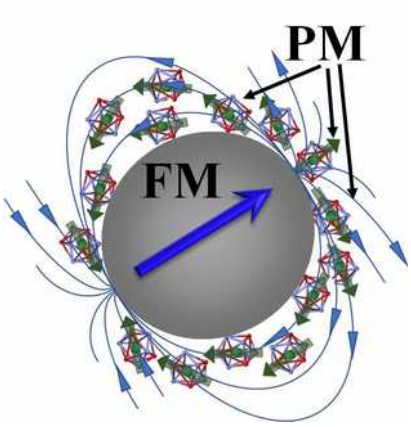

Fig. 1. Model of a composite material based on PrDyFeCoB microparticles (MP) and Er^{3+} complex (PM). The internal field of particles is indicated by an arrow. The Er^{3+} complex is located in the region of the stray field of microparticles.

In this work, the frequency dependences of magnetic susceptibilities, individual microparticles, individual SIM powder, as well as their composite were studied. Comparison of the dependences $\chi'(f)$ and $\chi''(f)$ in a mixture of the SIM complex and microparticles showed the presence of a peak in a zero external field at 2 K, although the pure complex did not show slow relaxation in the absence of a field. The stray field of PrDyFeCoB microparticles turned out to be sufficient to observe slow spin relaxation in the SIM complex. Two processes that affect relaxation are considered: orbital hybridization caused by chemical interaction between the compound and the metal surface; and magnetic dipole interaction provided by the residual magnetization of the matrix. It has been found that the magnetic relaxation of the [Er(HL)(L)]4CHCl3H2O complex can be controlled using a preliminarily applied external magnetic field.

The work was supported by the program of the Institute of Problems of Chemical Physics RAS AAAA-A19-119092390079-8.

[1] M.N. Leuenberger, D. Loss, *Nature* **2001**, *410*, pp. 789-793.