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Magnetic Properties of $Sr_2FeMoO_{6-\delta}$ Nanoparticles

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Strontium ferromolybdate (Sr2FeMoO6-d, SFMO) is a widely studied ferrimagnetic double perovskite. SFMO is a promising candidate for magnetic electrode materials for room-temperature spintronic applications because they present a half-metallic character (with theoretically 100% polarization), a high Curie temperature (T_C) of about 415 K, and a low-field magnetoresistance [1].

Recently, an inhomogeneous magnetic state was obtained in SFMO nanoparticles fabricated by solid-state reactions from partially reduced SrFeO3-x and SrMoO4 precursors by studying the temperature dependences of the magnetization measured in the field-cooling (FC) and zero-field-cooling (ZFC) modes and small-angle neutron scattering [2]. This state was attributed to the frustration of the exchange bonds and the simultaneous occurrence of various magnetic states: antiferromagnetic, ferrimagnetic, and superparamagnetic when the spin inversion does not change the energy of the system in a wide range of temperatures.

We fabricated nanosized SFMO particles with a narrow size distribution around ca. 70 nm by the citrate-gel technique. Single-phase composition and superstructure ordering degree were proved by X-ray diffraction. Superparamagnetic behaviour was demonstrated by magnetization measurements using ZFC and FC protocols as well as by electron magnetic resonance. The linear slope of the shift of the resonance field Br versus reduced temperature served as the basis for the derivation of an approximate 4/3 power dependency of the magnetocrystalline anisotropy constant on the reduced temperature $J = (1 - T/T_C)$. The origin of the simultaneous superparamagnetic and blocked behaviour was attributed to a nanoparticle size distribution around a value on the order of the critical diameter of single-domain particles.

[1] K.I. Kobayashi et al., Nature **395**, 677 (1998).

[2] N. Kalanda et al., J. Mater. Sci. **56**, 11698 (2021).