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Thin films of hexacyanometallates: towards tunable magnetic properties

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In the last few years, there has been a significant interest in the study of the molecular magnets in a form of thin films, that is motivated by the possibility of applying these materials as multifunctional sensors or in spintronic devices. One of the most important group of molecular magnets, which can be considered as relevant for such applications are cyanido–bridged coordination networks. A well–known example of that kind of compounds are Prussian blue analogues (PBA), a large family of cubic systems with face-centred crystal structure containing hexacyanometallates and transition metal ions. PBAs attract great attention due to interesting and tunable properties. The cyanido bridging ligands allow the effective magnetic coupling. Because of the highly symmetrical structure, the PBA's properties can be tuned by changing the transition metal ions involved in the cyano-bridging process.

Herein a study of a new dimensionally-reduced systems based on nickel hexacyanoferrate/chromate will be presented. Thin films were obtained with the "layer by layer"deposition technique, whereby the chemical composition was controlled by the dipping sequence. The primary aim of our work was to tune the physical properties of PBAs by adapting the strategy of incorporation of the three types of metal ions. A comprehensive analysis of magnetic, structural and spectroscopic properties of the resulting compound and the detailed investigation of the evolution of material's microstructure induced by the change in its chemical composition will be presented.

In addition we will present the first example of study on the magnetocaloric effect (MCE) in molecular magnet prepared in a form of thin film. Contrary to the compounds with magnetocrystalline anisotropy, anisotropic magnetic properties of PBA films are related almost only to shape anisotropy. The different magnetic response measured for sample oriented parallel and perpendicular to the direction of magnetic field has been explained by the geometry of a demagnetization factor. Besides the analysis of the magnetic entropy temperature dependence and its variation upon the rotating the sample from in- plane to out-of- plane orientation, we have studied the scaling behaviour of MCE for the sample in both positions.

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