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Book of Abstracts

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CONCENTRATION-DEPENDENT ANTIFERROMAGNETIC CORRELATIONS IN MULTI-SITE $Sr(Y_{1-x}Yb_x)_2O_4$ OXIDES

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Nowadays, crystalline compounds with the general formula of SrR_2O_4, where R is a rare earth (RE) ion, attract an attention of the researchers because of quasi-1D crystal structure, magnetic frustration in zig-zag chains of RE ions and substantially different anisotropic magnetic properties of RE ions at four magnetically nonequivalent sites with the C_s point symmetry. Among the peculiar properties of the up-to-date studied compounds, one can mention a coexistence of a long-range antiferromagnetic and a short-range incommensurate magnetic order in $SrEr_2O_4$ and $SrHo_2O_4$ and the absence of the long-range magnetic correlations in $SrDy_2O_4$ down to the lowest temperatures achieved in the experiments.

Another member of this family, $SrYb_2O_4$, undergoes a transition to the non-collinear antiferromagnetic phase at $T_N = 0.9$ K that has been revealed by studies of the inelastic neutron scattering and the heat capacity [1]. These studies, however, didn't provide any information about the electronic structure of Yb^{3+} ions and the nature of interactions which induce the observed magnetic ordering. Some parameters of the magnetic structure should be revised because the values of magnetic moments of the Yb^{3+} ions presented in [1] are not consistent with the measured field dependencies of the magnetization.

We present the results of a systematic investigation of spectral and magnetic properties in the concentration series of $Sr(Y_{1-x}Yb_x)_2O_4$ single crystals with $x = 10^{-4}$, $5\cdot10^{-3}$, $5\cdot10^{-2}$, 10^{-1}, $2\cdot10^{-1}$, $5\cdot10^{-1}$, 1. The samples were grown by the optical floating zone technique from the high-purity initial components. Energies of the crystal-field sublevels of the ground $^2F_{7/2}$ and excited $^2F_{5/2}$ multiplets for the two structurally non-equivalent sites Yb1 and Yb2 were determined by means of the site-selective laser spectroscopy of the strongly diluted ($x = 10^{-4}$) sample. EPR study of the same sample allowed us to characterize the single-ion magnetic anisotropy (principal values and axes of the *g*-tensors) for the ground states of Yb^{3+} ions at both Yb1 and Yb2 sites.

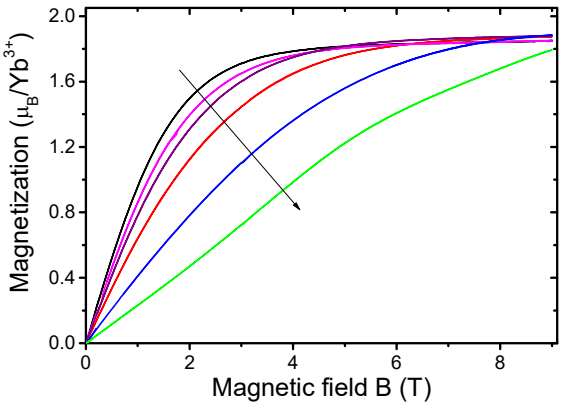

Fig. 1. Magnetization of the $Sr(Y_{1-x}Yb_x)_2O_4$ series at $T = 2$ K and $\boldsymbol{B}||c$ (x values along the arrow are 0.005; 0.05; 0.1; 0.2; 0.5; 1).

Crystal-field parameters for Yb^{3+} ions were found from the optimal simultaneous fit of the crystal-field energies and *g*-tensors for Yb1 and Yb2 sites. These data served as a basis for a description of the magnetization curves in $Sr(Y_{1-x}Yb_x)_2O_4$ compounds (Fig. 1) with higher Yb-concentrations. A set of exchange interaction parameters were found that allowed us to describe the observed suppression of the magnetization with the Yb-concentration increase. Collected data are used to model the magnetic structure in the $SrYb_2O_4$ single crystal at $T < T_N$.

[1] D.L. Quintero-Castro et al, *Phys. Rev. B*, **86** (2012) 064203.