Magnetic properties of $Cu[C_6H_2(COO)_4][H_3N\text{-}(CH_2)_2\text{-}NH_3]\cdot 3H_2O$ - a quasi-two-dimensional $S = 1/2$ antiferromagnet on rectangular lattice

R. Tarasenko,[1] P. Danylchenko,[1] A. Orendáčová,[1] J. Strečka,[1] E. Čižmár,[1] V. Tkáč,[1] and M. Orendáč[1,2]

[1]*Institute of Physics, Faculty of Science, P.J. Šafárik University, Park Angelinum 9, 041 54 Košice, Slovak Republic*

[2]*Department of Solid State Engineering, University of Chemistry & Technology, Technická 5, Prague 16628, Czech Republic*

The analysis of specific heat, magnetic susceptibility and magnetization identified the studied compound $Cu[C_6H_2(COO)_4][H_3N\text{-}(CH_2)_2(\text{-}NH_3]\cdot 3H_2O$ as a quasi-two-dimensional $S = 1/2$ Heisenberg antiferromagnet on the rectangular lattice. A phase transition to a magnetically ordered state was observed in zero magnetic field at $T_N =$ 1.28 K. The best agreement with experimental data was observed for the rectangular lattice model with antiferromagnetic intrachain coupling $J_1/k_B \approx 7.39$ K and ratio $R \approx 0.44$. The analysis of magnetic specific heat in non-zero magnetic fields revealed features characteristic for the field-induced Berezinskii-Kosterlitz-Thouless (BKT) phase transition theoretically predicted for ideal two-dimensional magnets. It was found that the transition temperatures of $Cu[C_6H_2(COO)_4][H_3N\text{-}(CH_2)_2(\text{-}NH_3]\cdot 3H_2O$ are higher than the BKT temperatures from theoretical predictions. This difference was ascribed to the effect of interlayer interactions. The electron paramagnetic resonance studies of $Cu[C_6H_2(COO)_4][H_3N\text{-}(CH_2)_2(\text{-}NH_3]\cdot 3H_2O$ revealed the increase of g_x and g_y and decrease of g_z below 25 K due to the presence of dipolar coupling and the exchange anisotropy. The upturn of linewidth appearing below 30 K can be ascribed to the development of intralayer magnetic correlations. In the future, the band-structure calculation will be performed to evaluate individual exchange couplings to confirm present results.

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