

Formation of correlated spin systems in one-and two-dimensional copper and lanthanide compounds.

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Streszczenie

Electron paramagnetic resonance (EPR) of the systems of exchange-coupled ions differing strongly by spin-lattice relaxation times are discussed. The physical description of a rapid process which modulates and averages out the other, more slow one, is extended to the situations when paramagnetic ions participate in several exchange processes. The layered copper-neodymium squarate, $[\text{CuNd}_2(\text{C}_4\text{O}_4)(4)\text{H}_2\text{O}]_n$ (I), and the one-dimensional copper-lanthanide Cl-3-acetates, $\text{CuLn}_2\text{X}(\text{Cl}_3\text{CCOO})_8 \cdot 6\text{H}_2\text{O}$ ($\text{Ln} = \text{Nd}^{3+}$ (II), Pr^{3+} (III)), were investigated by X-band EPR in the temperature range 4.2-300 K. These compounds were shown to consist of subunits admitting exchange interaction between Cu ions, Cu-Nd ions and Nd-Nd ions. At high temperatures the short spin-lattice relaxation time of Nd^{3+} averages out the Cu-Nd exchange interaction. The manifestation of this interaction should be temperature dependent when governed by the spin-lattice relaxation of one of the partners. The collective Cu spin-system exists in I at $T > 250$ K ($J(\text{Cu-Cu})$ approximate to 0.1 cm^{-1}) and gradually transforms into Cu-Nd spin-system which dominates at $T < 20-30$ K ($J(\text{Cu-Nd})$ approximate to 0.4 cm^{-1}) with $J(\text{Cu-Nd}) > J(\text{Cu-Cu}) > J(\text{Nd-Nd})$. Polymer chains in II may be considered as weakly interacting asymmetrical triads -Nd-1-Cu-Nd-2- (with the largest components of $J(\text{if})$ tensor 30.3 cm^{-1}). For III the lowest state of Pr^{3+} was proved to be a nonmagnetic singlet with $J(\text{Cu-Pr})$ equal to zero. Very weak, temperature-dependent exchange interaction between Cu^{2+} ions via two Pr^{3+} ions ($J(\text{Cu-Cu})$ approximate to 0.015 cm^{-1} at $T=4.2$ K) was observed.

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