Jahn-Teller Exchange Clusters in "Breathing" Crystals. Theory of Thermo- and PhotoInduced Spin Crossover Like Transitions

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Compounds of "breathing" crystals family [1] containing the Jahn-Teller exchange clusters are well-known for the ability to demonstrate numerous spin crossover like transitions. The transitions can be induced by change of temperature, photo illumination or applying external pressure. On the basis of random field distributions approach developed in the Ising magnets theory we suggest a new theoretical description of thermal transitions for these molecular systems. The developed approach involves not only pure crystals but also the case of random impurities of non Jahn-Teller metals in the "breathing" crystals. The impurities decrease cooperative effects in thermal transitions of the Jahn-Teller exchange clusters making the transitions smoother.

Interaction of polymer chains is known to be one of the important physical factors affecting magneto-structural transitions in "breathing" crystals compounds. We show the inclusion of interchain interaction can result not only in strengthening spin crossover like cooperative transitions of exchange clusters, but sometimes to slow down the thermal transitions [2].

Relaxation kinetics of photoexcited states in "breathing" crystals usually manifest a *self-decelerating character* in contrast to analogue of this phenomenon – the LIESST effect (Light-Induced Electron Spin-State Trapping [3]) well studied for Fe(II) spin-crossover compounds. The self-decelerating kinetics phenomenon is associated with a few relaxation rates of different types of photoexcited states in the crystals.

The suggested kinetic approach qualitatively explains the difference of relaxation kinetics at various initial excitation intensity observed in experiments on photoexcitation of "breathing" crystals [4].

We also discuss an additional mechanism of the observed polychromatic relaxation due to a macroscopic distribution of relaxation rates inside inhomogeneously photoexcited samples of "breathing" crystals.

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