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Dielectric Properties for Metal Complexes with Dynamic Electrons

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The conversion between two electronic states of a metal center in an organo-metallic/inorganic complex leads to a molecular material presenting a hysteresis cycle when the two electronic states of the molecules are equally obtained under a given external perturbation. The switching between two electronic states is governed by short and long range cooperative interactions in the material, which result in the occurrence of the hysteresis loop. For example, the compound $[Cu(dieten)_2](BF_4)_2$ displays a first order phase transition with a hysteresis loop around room temperature (ΔT = 7 K between $T_c\uparrow$ = 294 K and $T_c\downarrow$ = 287 K).

These molecular systems display a variety of properties that might be used to store and read information at the molecular level. Besides thermal addressing, switching of spin-states by short magnetic, light or pressure pulses in the thermal hysteresis interval has been reported recently. Concerning the reading process, the phase transition behavior is usually detected by magnetic susceptibility, optical reflectivity, vibrational spectroscopy or heat capacity measurements. However, among these methods only optical reading seems to have some potentiality in actual devices, though with limited spatial resolution.

The phase transition phenomenon is accompanied by a spontaneous distortion of the coordination sphere of the metal center, but is not intrinsically associated with a change of the crystal space group of the material. This intramolecular structural change involves a deformation of the electronic molecular orbitals of the complex. Therefore, the local electrical dipoles in the material must be different in the two electronic states, leading to a change in dielectric properties of the material upon dynamic electronic states. In this presentation we will report the change of dielectric constant upon metal complexes with dynamic electrons.

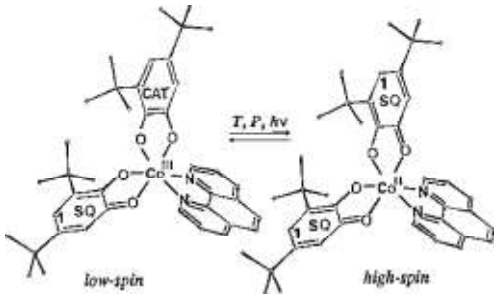

Fig. 1 Valence tautomerism in cobalt(II) compound.

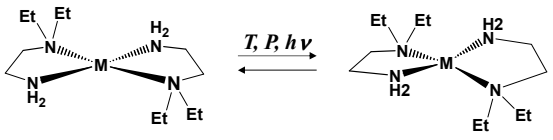

Fig. 2 Structural change for thermochromic compound.