Luminescent Spin Transition Complexes – Towards Optical Read-Out of Spin-State Switching

Bernhard Schäfer, A., Sergei Lebedkin, A., Manfred Kappes, A., Mario Ruben, A. B.

A. Institut für Nanotechnologie, Karlsruher Institut für Technologie, Postfach 3640, 76021 Karlsruhe, Germany
B. Institute de Physique et Chimie des Matériaux de Strasbourg (IPCMS), Université de Strasbourg, France

Spin transition (ST) compounds have increasingly moved into the focus of scientific interest due to their potential applicability in molecular devices. The pronounced bistability between high spin (HS) and low spin (LS) states is a very attractive property of ST materials and it was proposed to use such compounds as active units for information technology applications. However, in order to process the ST compounds into functional devices it is required that the material shows abruptness of transition, wide thermal hysteresis behavior, stability, and room temperature transition temperature.[1]

We will present the synthesis of unprecedented luminescent spin transition complexes with the aim to probe the magnetic properties of the prepared systems using optical methods. Such polynuclear entities should consist of a spin transition center (STC), a luminescent metal center (LC), and a bridging ligand that is interconnecting both centers.

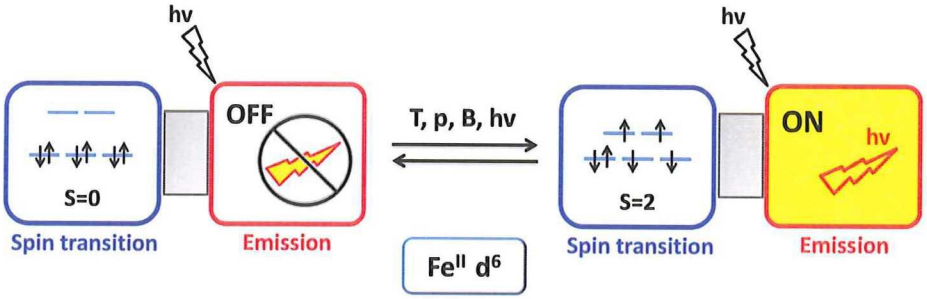

Figure 1: Schematic representation of a luminescent spin transition complex, a change of the spin state of the ST center (blue color code) from LS to HS or vice versa is planned to trigger the on-/off-switching of the emission of the luminescent center (red color code)

With respect to pivotal room temperature switching, iron(II)-bis(pyrazol-1-yl)pyridine complexes, $Fe(bpp)_2$, is one of the families of complexes in which the room temperature ST occurs quite often.[2] This makes the $Fe(bpp)_2$ unit to be a prospective and promising candidate that is known to operate as a spin transition center. An external trigger, e.g. light, temperature, or pressure, enables the switching of the spin state of the Fe(II) ion between the low-spin state and the high-spin state, see figure 1.[3] Two bpp ligands coordinate an Fe^{II} ion in an octahedral geometry. The ligand field of the bpp ligands stabilizes the coordinated Fe^{II} center and allows a change between the two spin states that often occurs at room temperature.[3]

Hybridization of both centers (STC and LC) is mediated by the aromatic π backbone of the bridging ligand. The hybridization is expected to drive a change of the luminescence properties of the luminescent center when the electronic states are modified upon ST of the ST center. Such changes should lead to a) on- or off switching of the luminescence, b) a shift in the luminescence wave length, or c) a change in the luminescence intensity.

[1] a) O. Kahn, C. Jay Martinez, *Science* **1998**, 279; b) M. Cavallini, I. Bergenti, S. Milita, G. Ruani, I. Šalitroš, Z. Qu, R. Chandrasekar, M. Ruben *Angew. Chemie* **2008** 47, 45, 8596.
[2] a) I. Šalitroš, T. Madhu, R. Boča, J. Pavlik, M. Ruben *Monatsh. Chem*. **2009**, 140, 695; b) M.A. Halcrow *Coord. Chem. Rev.* **2009**, 253, 2493.
[3] a) O. Kahn, Molecular Magnetism; Wiley-VCH:New York, **1993**. b) J.M. Holland, J.A. McAllister, Z. Lu, C.A. Kilner, M. Thornton-Pett, M.A.Halcrow Chem. Commun., **2001**, 577.