Metallorganic Frameworks as Quantum Sensors and Magneto-Optically Responsive Materials

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Coordination chemistry approaches can be efficiently used to conceive and synthesize Functional Molecular Materials for challenging technological applications, such as quantum information processing, quantum sensing, or photonics. The key in this approach is the choice of the molecular building blocks and their organization in extended molecular structures.

The aim of this communication is to present recent results obtained in this direction focused on *i)* the precise organization of electronic molecular spin qubits into extended metal-organic frameworks (MOF)[1] and *ii)* the investigation of magneto-chiral dichroism, a peculiar and scarcely investigated magneto-optical phenomenon of chiral magnetic materials, in a 2D-layered chiral ferrimagnet with high ordering temperature.[2] The former study demonstrates that quantum coherence properties of a 3D framework of vanadyl-porphyrinate complexes can retain quantum coherence times of the order of 1 μs up to room temperature despite the complex structural environment of this 3D structure. This effect has been related to the high rigidity of the framework, as suggested by low-energy vibrations spectrum determined by time-domain THz spectroscopy.[1] Moreover, as a consequence of the large channels in this MOF, this material can be further investigated as a potential quantum sensor. The latter study involves the investigation of the magneto-optical response of a chiral heterometallic 2D-layered material based on ferrimagnetically coupled Cr(III) and Mn(II) ions.[2] Preliminary magneto chiral dichroism (MChD) measurements in the Vis-NIR range show a strong MChD response, with opposite sign for two enantiomeric crystals, up to 40 K, the ferrimagnetic ordering temperature of the material.[3] The spectrum is very rich and allows to determine the respective role of each metal ions onto the MChD signal. Moreover, the high temperature at which the signal is observed calls for further chemical modifications to push forward the observation of MChD up to technologically relevant temperatures.

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2 K. Inoue, K. Kikuchi, M. Ohba, H. Okawa, *Angew. Chem. Int. Ed.*, **2003**, *42*, 4810.
3 M. Atzori, I. Breslavetz, G. Rikken, C. Train, *unpublished results*.