

The development of new electronic technologies requires the design of new smart materials, which can react to external stimuli, like temperature, pressure or light irradiation, by changes in magnetic and optical properties. Molecule-based materials, which are constructed from metal ions and organic and inorganic fragments bound together into extended structures, combine at the molecular level a wide range of desirable properties, including magnetism, thermochromism and photosensitivity. Moreover, their properties, thanks to the construction based on the building block principle, can be easily tuned by the exchange of selected components. Molecule-based materials offer an interesting alternative to classical inorganic oxides and metals used in modern electronics, which present several drawbacks, including limited possibility of miniaturisation and high energy consuming production processes. The developments in the field of molecular magnetism brought about an abundance of astonishing multi-stable and multi-responsive systems, which show intricate interplay between magnetism, photosensitivity, sorption ability, optical activity or electrical conductivity. Nevertheless, practical application of the functional potential of these compounds requires their preparation in a robust form, in which they can be easily processed and integrated into complex devices without compromising their functionality. Molecule-based materials in their original crystalline form are usually brittle and show poor surface stability. Their properties are often easily destroyed by contact with air, changes in humidity and temperature, or exposure to mild chemicals.

The aim of this project is the development of the preparation methods of nanocomposite materials integrating functional molecule-based systems into organic polymer matrix. We will concentrate our efforts on compounds which show magnetic and optical response to temperature changes, application of pressure, and light irradiation. Selected candidate stimuli-responsive systems will be prepared as nanoparticles and then embedded in the organic polymer matrix and formed into thin films or electrospun fibres. Within the scope of the project we will investigate how the reduction in particle size to the nanometric scale and interactions with the polymer matrix influence the properties of the target molecular materials. The ultimate goal of the project is to obtain nanocomposite materials that combine switchability of molecular magnetics with sturdiness and favourable mechanical properties of organic polymers, and can be easily used for fabrication of thin films and fibres. Attaining this goal will bring us closer to the practical application of molecular magnetic materials in real-life working devices.