Multifunctional molecular materials - bridging magnetism and luminescence

Initiative: Trilaterale Partnerschaften – Kooperationsvorhaben zwischen Wissenschaftler(inne)n aus der

Ukraine, Russland und Deutschland

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The molecular approach to materials is a fast growing field in modern science. Multifunctional molecular materials are both important to fundamental scientific interest and for potential applications. A distinctive feature of molecular materials is either competition, coexistence, or cooperation of different physical and chemical properties, such as magnetism, optical properties, redox-activity or conductivity. The present project focuses on molecular materials that unite the key properties of magnetism and luminescence. This property combination is still an exception today as paramagnetism diminishes luminescence usually. However, a successful implementation of both properties in one compound allows for materials properties that emerge from the influence of magnetism on luminescence and vice versa. Thereby, the project has the aim to develop a novel sensing type benefitting from this property dependence. In order to achieve the objectives, it is essential to provide a rational design of polyfunctional magnetic and luminescent molecular materials based on complexes and coordination polymers of 3d- and 4f-metal ions, including MOFs and frameworks based on oligonuclear molecular building blocks such as metallacrowns. The synthesis of these compounds will be achieved by different syntheses strategies that include the expertise of the participating groups on the formation of molecular building blocks with 3d- and 4f-metal ions, the implementation of intrinsic magnetism including options for single-molecule magnets as well as intrinsic luminescence, and finally on sensing such a property dependent detection processes. Therefore, the project relies on the synthesis and determination of all relevant properties by fair collaboration of the participating groups of all three countries according to their expertise. These results will be gathered and evaluated to achieve both fundamental knowledge on the options to combine magnetism and luminescence as well as potential new applications in sensing and detection. This kind of sensing includes detection that can in principle be observable ?on-the-fly" by the eye, when strong defined changes in the luminescence are caused by changes of the magnetic moments due to interaction of the molecule with a certain analyte gas, a liquid molecular species such as a solvent or an additional molecular magnetic spin center.

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