DESCRIPTION FOR THE GENERAL PUBLIC

Recent rapid technological advancement requires multifunctional materials capable of exhibiting at least two distinct electrical, optical, magnetic, or mechanical properties. Primarily, the combination of two physical features in a single material is attractive due to the high demand for miniaturization, which is notably evident in modern electronics. Furthermore, multifunctional materials can demonstrate a coupling effect between two interplaying functionalities, resulting in a strong impact of the first property on the second one. It was successfully implemented in chemical sensors that use absorption properties, in which the sensitivity of the material to specific chemical compounds impacts optical properties, such as the color of a compound.

One of the most important properties from the perspective of material science is luminescence, which can be defined as the light emission of a material caused by the influence of external stimuli. Particular attention is put on photoluminescent materials in which light emission occurs upon irradiation by light photons of different energies. Luminescent materials have broad applications, including light-emitting diodes (LEDs), lasers, photovoltaic devices, optical amplifiers, optical data storage, optical thermometry, and bioimaging tools. Another important property in today's material science is chirality, derived from the Greek word *kheir* “hand”, which is a property of asymmetry, distinguishing an object from its mirror image, resulting in two nonsuperimposable objects. Combination of the chirality and photoluminescence within one material and their interplay may result in emission of left- or right-polarized light, called circularly polarized luminescence (CPL).

The use of an electric field sets an appealing route for modulation of the optical and chiro-optical material output. Furthermore, the scientist reports that photoluminescence may be efficiently modulated with an electric field. That can be achieved in a special class of luminophores that combine photoluminescence with an additional physical property called ferroelectricity. Ferroelectricity is a property of a material resulting in the existence of spontaneous electric polarization that can be reversed by the application of an electric field. This polarization effect is a consequence of the electric-field-induced displacement of polar molecule units in their crystal structure, which is still observable when the external field is turned off, resulting in hysteresis, that is, the dependence of material state on its “history”. The detectable remnant polarization exists and may be reversed, therefore, two coexisting phases can be created, opening up uses of ferroelectrics in memory systems, and switches.

The project aims to design, synthesize, and characterization of chiral ferroelectric molecular luminophores, based on organic-inorganic molecular hybrids, obtained by the combination of chiral and polar organic cations with inorganic manganese(II) halides, that can exhibit both circularly polarized luminescence and ferroelectricity at room temperature. Thanks to resulting materials’ multifunctionality, is expected that an electric field can efficiently modulate the intensity and of light emission and it dissymmetry factor. This effect is related to the electric-field-induced polar displacement, which will affect the structure of the material and consequently its photoluminescent and chiro-optical properties. Therefore, the project will result in their improved understanding, allowing for the development of synthetic approaches for obtaining of novel chiral luminescent ferroelectrics for a variety of chiro-optoelectronic applications. Thus, the project will provide a significant contribution to modern research on functional molecular materials, specifically multimodal optical switches.