

**Popular scientific abstract of the project „Fabrication and characteristics of new liquid-crystalline materials comprising chiral ionic compounds for application in light modulators”**

The aim of the project is synthesis and utilization of new type of compounds – salts with chiral ions having opposite twisting sign of the liquid crystalline phase. Chiral compounds may be distributed by means of direct electric field in the liquid crystalline cell in such a way, that the helical structures of different magnitude in range comparable with visible light wavelength will appear, causing reflection of light of different wavelengths, even covering the whole visible spectrum.

The project assumes possibility of separation of chiral ions of opposite twisting sign under the direct electric field, which cause twisting of the liquid crystalline phase in two opposite directions to form helical structures reflecting the light of opposite circular polarizations. Thereby, it is possible to obtain the reflectivity of light up to 100% inside single layer.

The effect of reflection of light may be applied in light modulators, e. g. reflective displays like e-paper or smart windows. In liquid-crystalline materials doped with ionic compounds it is possible to maintain the wideband reflection even up to 7 days after ceasing of the electric field, what is especially advantageous with respect to saving of energy in this type of devices.

In the project, the salts containing two chiral ions having opposite twisting sign of the liquid crystalline phase, which will be based on the commercially available compounds having chiral anions, e.g.  $\alpha$ -substituted carboxylic acids and their salts and synthesized cations based on the cyclic amines with unsaturated rings including the imidazole group and natural compounds like menthol and terpenes.

In the next step, the salts and compounds with single chiral ions will be introduced to the liquid crystal. The miscibility of these compounds, the helical twisting power of the liquid crystal phase of particular chiral ions and the stability of the mixtures over the working conditions will be studied. The compounds will be modified by their chemical structure in order to enhance the miscibility.

On the basis of the liquid crystals with salts of opposite twisting sign chiral ions, the experiment verifying the posed thesis will be conducted – obtainment of reflectivity of light of circular polarization of two opposite directions in the single cell. The overall performance of the materials as modulators of light reflectivity and influence of particular chiral ions on this performance will be estimated.

In the second stage of characterization of mixtures of chiral ionic compounds with liquid crystals, the properties of induction of periodic structures acting as diffraction gratings will be studied. They are induced in mixtures by means of alternating voltage and cause decrease of the transmission of polarized light. The project assumes investigation of frequency ranges with respect to the used chiral ionic dopants and determination of the reason of grating formation in these ranges of frequency. Moreover, for materials enclosed in the hybrid cells, the rotation angle of the diffraction grating will be characterized upon the change of the electric field. It is possible to switch the optical state in the materials by means of change of frequency or/and amplitude of the alternating voltage, what allows for their application in dynamic optical switches, e. g. switchable and electrically-steering polarizers, smart windows, etc.