

Summary of the doctoral dissertation:

Ferroelectricity in organic-inorganic hybrids based on the pyrrolidinium cation

The constantly evolving electronic technology provides new devices, but also stimulates the search for new materials combining the desired electrical characteristics with cheap production costs and, more importantly, lower disposal costs. A promising group of compounds seems to be organic-inorganic hybrids, made of metal halides, being the anionic part, and organic cations.

The doctoral thesis is the result of searching for new materials from the group haloantimonates (III) and halocobaltates (II) based on a pyrrolidinium cation: its main aim was to perform a complete physicochemical characterization of four new materials: $(\text{C}_4\text{H}_8\text{NH}_2)_2[\text{SbCl}_5]$ (PCA5), $(\text{C}_4\text{H}_8\text{NH}_2)_3[\text{Sb}_2\text{Cl}_9]$ (PCA9), $(\text{C}_4\text{H}_8\text{NH}_2)_2[\text{CoBr}_4]$ (PCB) and $(\text{C}_4\text{H}_8\text{NH}_2)_2[\text{CoCl}_4]$ (PCC) based on available experimental techniques over a wide temperature range. On the basis of the performed structural, thermal, spectroscopic, optical and microscopic studies, an attempt was made to explain the mechanisms of the occurring phase transitions observed in the obtained materials.

The dissertation consists of a theoretical part introducing ferroelectric materials, history, application, basic properties, as well as the current state of knowledge in the field of organic-inorganic hybrids containing Sb(III), Bi(III) and Co(II). The research part presents the experimental results for the synthesized compounds.

The most important achievements of the doctoral dissertation are the obtaining of two new ferroelectrics from the groups R_2MX_5 and $\text{R}_3\text{M}_2\text{X}_9$, where R is an organic cation, M is Sb (III) or Bi (III) and X as a halide. Both compounds are characterized by a complicated situation of phase transitions. Additionally, in the low-temperature phases they show ferroelastic properties. The domain structure of PCA9, which resembles a herringbone pattern in the Phase V, is particularly surprising. Cobalt-containing materials undergo two reversible phase transitions and exhibit ferroelastic properties. The mechanism of the phase transitions in the obtained materials is related primarily to the dynamics of the pyrrolidinium cation.