

Doctoral dissertation: Izabela Czopek

“Glass-ceramic materials containing PbWO_4 crystalline phase and selected lanthanide ions and their luminescence properties”.

Recently, there is a great interest of technology and physicochemistry of optical materials in Transparent Glass Ceramics (TGC). The TGC systems can be produced from the partial crystallization glasses when parameters of heat treatment are properly optimized. Doping of lanthanide ions provides opportunities of applications these materials as promising centers emitting light in the visible and near infrared range. Crystallization controlled by temperature of the optical glasses is a way for receiving stable crystals, often as a nanocrystals distributed in the glass matrix. The spectroscopic consequence of transition from glass to glass-ceramics is obtaining of transparent systems with a narrower, more intensive emission lines and elongated luminescence lifetimes of excited states lanthanides. Glass-ceramics can combine the features of both amorphous as well as crystalline centers. Spectral characteristics of these materials are very interesting not only for applications in widely understood optic point of view, but also in understanding their structure and properties.

The doctoral dissertation concerned on preparation and determination of optical properties of glass-ceramics containing nanocrystals PbWO_4 and lanthanide ions. They may be used in optoelectronics as source that is emitting radiation in near infrared and visible light range. Single PbWO_4 crystals obtained by traditionally Czochralski or Bridgman methods are known from their unique properties. Thus, they were used for detectors construction in Large Hadron Collider in CERN. Rapid development of nanotechnology in the last years, and the restrictions resulting from structure defects in single crystals caused searching for new solutions for receiving nanocrystals of the PbWO_4 phase.

In particular, the scientific aim of the doctoral dissertation was: producing transparent glass-ceramic systems containing lead tungstate crystalline phase and selected lanthanide ions by controlled heat treatment of precursor lead borate glasses; determination of the correlation between chemical composition; nanocrystalline PbWO_4 (condition of heat treatment of the glasses) and optical properties in glass-ceramics containing lanthanide ions; analysis of the luminescence properties of systems containing PbWO_4 phase and lanthanide ions in visible light and near-infrared range; determination of the crystallites PbWO_4 influence on optical properties of lanthanide ions in lead borate glass system.