Synopsis of the PhD thesis

Technology of sol-gel materials containing PbF_2 nanocrystals and their selected properties

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In recent years oxyfluoride glass-ceramic materials containing fluoride nanocrystals doped with rare earth elements have been extensively investigated due to their interesting optical properties and applications in optoelectronics. The sol-gel process is one of the techniques used to obtain fluoride nanocrystals. Low-temperature sol-gel method is characterized by a high degree of purity of the obtained materials and homogeneity at the molecular level. Lanthanide doping provides to obtain fluoride nanocrystals with unique optical properties. The most interesting rare earth ions are Eu^{3+} and Tb^{3+} emitting light in the visible spectral range (red and green, respectively).

The aim of the PhD thesis was to obtain low-temperature sol-gel materials containing PbF_2 fluoride nanocrystals and optically active dopants (Eu^{3+} and Tb^{3+}). To achieve this objective as first precursor silicate xerogels were obtained. Then the structural and optical properties of sol-gel materials before heat treatment were investigated. The heat treatment of precursor xerogels was carry out to obtain PbF_2 nanocrystals. Received nanocrystals were characterized using X-ray diffraction and selected microscopic and spectroscopic methods. Optical properties (luminescence spectra and their decays) of sol-gel materials containing PbF_2 fluoride nanocrystals were investigated. The luminescence intensities and lifetimes of rare earth ions are enhanced due to presence of the optically active ions (Eu^{3+} i Tb^{3+}) in the crystalline phase PbF_2 and the losses of hydroxyl groups during heat treatment of precursor silicate xerogels.