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Optical study of phase transitions of mixed perovskite nanocrystals CsPb(BrxI1-x)3 obtained in borogermanate glass

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Optical materials based on cesium lead halide perovskite nanocrystals are promising due to their unique optical, optoelectronic and photoelectric properties. The convenience of using perovskite nanocrystals in applications such as LEDs, solar cells, etc. lies in their ability to smoothly adjust the position of luminescence depending on the ratio of halogen ions, obtaining mixed nanocrystals. The glass ceramics obtained in this work, in particular, can be used as a luminescent material, laser media, and scintillators for X-ray imaging.
However, one of the difficulties when working with materials containing perovskite nanocrystals is that they have several phase transformation points at relatively low temperatures (30 –330 ℃), which affects their optical properties, so the study of temperature effect on these new materials is extremely important.
In this work, borogermanate glass ceramics with mixed CsPb(BrxI1-x)3 perovskite nanocrystals were synthesized and studied. A study of their spectral and luminescent properties showed that an increase in the concentration of iodine in the composition of glass ceramics leads to an increase in the band gap of nanocrystals and a shift of their luminescence and absorption spectra to longer wavelengths. It was also shown that equimolar replacement of bromine with iodine in the composition of mixed nanocrystals increases the luminescence quantum yield of glass ceramics by up to 35%. Temperature measurements show that hysteresis is observed in the dependence of optical density on temperature in the heating-cooling cycle, and these measurements also made it possible to construct the dependence of the melting and crystallization temperatures of nanocrystals jbtained in the glass matrix on the ratio of bromine and iodine in the composition of the nanocrystals.
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