Optical properties of double perovskite $Cs_2Ag_{0.2}Na_{0.4}In_{0.6}Si_{0.4}Cl_6$

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Recently, a lot of research has been carried out in the field of optical properties of perovskites. The step in improving materials for electroplating, electronics, solar cells and other applications is the study of the properties of double halide perovskites.

Double halide perovskites are a class of crystalline materials that have a structure similar to perovskite (ABX_3), but with one or more ions replacing other ions in that structure, and contain halides (F-, Cl-, Br-, I-) in as anions X. Since the double halide perovskites are ionic crystals, their charge carriers in the form of electron-phonon coupling are strongly related to lattice vibrations. And this interactions helps to understand electrical and optical properties of double perovskites. Also of great interest in the study of double halide perovskites are mixed perovskites with three cations, which can significantly expand the absorption spectrum and increase the quantum yield of luminescence due to synergistic effects. Our research is about the mixed double perovskite $Cs_2Ag_{0.2}Na_{0.4}In_{0.6}Si_{0.4}Cl_6$.

Double halide perovskites synthesis is based on dissolved poly-crystalline powder of starting material in hydrohalic (HX, X = Cl or Br)/hypophosphorous acid mixed solvent [1]. After heating to 100-200 K, it should be slowly cooled at a rate 0.5 Celcius degrees in an hour [2]. The XRD pattern recorded for $Cs_2Ag_{0.2}Na_{0.4}In_{0.6}Si_{0.4}Cl_6$ shows that the collected pattern matches very well to the desired phase attributed to the 04-007-2290 powder diffraction file. The main peak of the material structure is centered at 2= 24°. The lattice constant is 10.51 A. Some other XRD diffraction lines, located at 14.5°, 28°, 34°, 42°, 48.96°, and others.

We registered the optical properties of $Cs_2Ag_{0.2}Na_{0.4}In_{0.6}Si_{0.4}Cl_6$. Photoluminescence excitation spectra has only one maximum at 259 nm at observation 600 nm. After 340 nm no signal is registered. The luminescence band of perovskite was obtained at an excitation wavelength of 300 nm and is located in the region of 601 nm (orange-red). In $Cs_2AgInCl_6$ crystal, the emission band is observed at 630 nm [3]. The incorporation of Na and Si ions leads to the shift of photoluminescence band to shorter wavelength part.

It can be noted that alloyed perovskites with different ratio of Ag, Na, In, Si have an exhibit larger photoluminescence intensity, broad absorption spectrum compared to their single-component counterparts due to enhanced defect tolerance, and synergistic effects.

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