Synthesis of perovskite nanocrystals for radiation applications

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1. Introduction

Nanomaterials such as zero-, one- and two-dimensional structures have attracted significant research interest due to their outstanding electrical and optical properties [1-3]. In particular, the semiconductor-based nanocrystal and quantum dot have been recently proposed as promising candidates for the next-generation radiation detection materials owing to the high absorption coefficient, band gap tunability, easy solution processes, and long carrier diffusion length [4-6]. So that nanomaterials can be used for various optoelectronic applications, including solar cells, light emitting diodes, lasers, radiation detectors and many others. In this work, we focused on the synthesis and characterization of perovskite nanocrystals for radiation detection applications. The synthesis method for preparing CsPbBr3 nanocrystals is described and their size and optical properties are investigated in details.

2. Methods and Results

The CsPbBr3 nanocrystals were synthesized using the colloidal hot- injection method and purification process. Fig. 1 shows the high-resolution transmission electron microscopy (TEM) images of CsPbBr3 nanocrystals. The CsPbBr3 nanocrystals exhibited a cubic shape with the size of 9-17 nm.

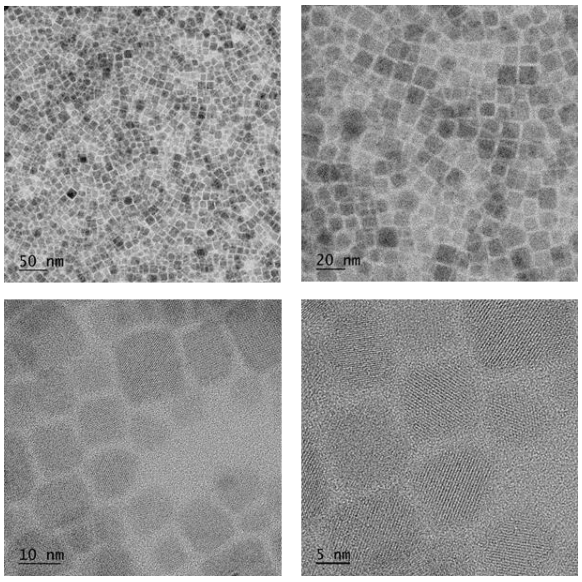

Fig. 1. High-resolution TEM images of CsPbBr3 nanocrystals.

The photoluminescence (PL) spectra of CsPbBr3 nanocrystals dispersed in nonpolar solvent are shown in Fig. 2. PL peak is located at 518 nm and full-width half-maximum was around 20 nm, which indicated that the prepared CsPbBr3 nanocrystals were highly pure phase.

Emission images of CsPbBr3 nanocrystal solutions examined under the UV excitation presented in Fig. 3. We also investigated the X-ray radioluminescence spectra of CsPbBr3 nanocrystal solutions.

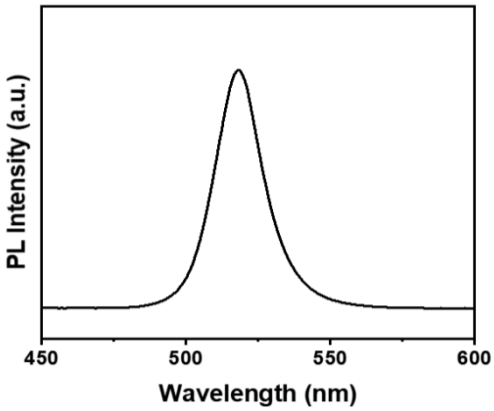

Fig. 2. PL spectra of CsPbBr3 nanocrystal solutions.

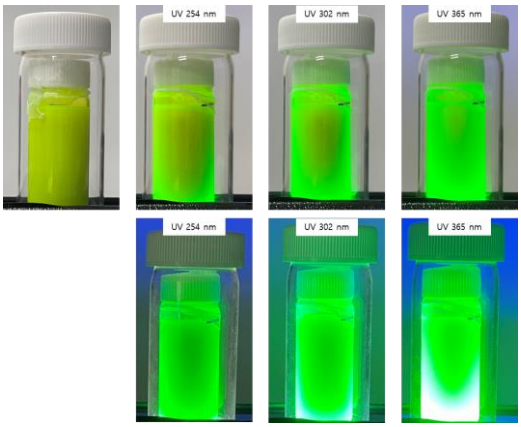

Fig. 3. Emission images of CsPbBr3 nanocrystal solutions.

3. Conclusions

In summary, we have presented that the synthesis method and characteristics of CsPbBr3 nanocrystals for the purpose of radiation detection application. The CsPbBr3 nanocrystals with good optical and structural properties were successfully synthesized. These results may be useful in the future research and development of high performance CsPbBr3 nanocrystal-based radiation detection devices.

ACKNOWLEDGMENTS

This work was supported by the Korea Atomic Energy Research Institute (KAERI) Institutional Program (Project No. 523160-23 and 523510-23) and the National Research Council of Science & Technology (NST) grant by the Korea government (MSIT) (No. CPS22111-100). This work was also supported by Grant RS-2022-00144108 funded by the Ministry of Trade, Industry and Energy of the Korean government.

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