Scintillation properties of flexible scintillator composed of PDMS and nanocrystals

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1. Introduction

Due to the low cost, easy fabrication and fast response time, organic scintillator materials have been widely used as detectors in nuclear, particle physics, and homeland security applications [1-3]. Most of the organic scintillators are composed with solvents, primary solutes (p-terphenyl (1, 4-Diphenylbenzene), PPO (2, 5-diphenyloxazole) and butyl PDB (2-4(biphenyl)-5-(4-tert-butylphenyl)-1, 3, 4-oxadiazole)), and secondary solutes (POPOP (5-phenyl-2-[4-(5-phenyl-1, 3-oxazol-2-yl)phenyl]-1, 3-oxzole)) [4-5]. Because of scintillator properties of the primary/second solutes, most of organic scintillator have an emission wavelength around 400 nm. Also the low effective atomic number of organic scintillator makes it challenging to detect high-energy X-ray/ γ-ray.

Nanocrystals have been used as light emitting diodes (LEDs) and sensors for bio-imaging [6]. As the size of the nanocrystals increase, the emission wavelength changes from blue to red. It also enables a higher absorption efficiency for X-ray/ γ-ray because of high atomic number (Z).

Organic scintillator are easy to mix other dopant materials. Thus it is possible to fabricate the nanocrystals doped organic scintillators.

At this paper, we present the scintillation properties of nanocrystals doped PDMS based organic scintillators.

2. Methods and Results

In this section, scintillation properties of the flexible scintillator composed PDMS and nanocrystals are described.

2.1 Flexible Scintillator

We fabricated flexible scintillator composed of PDMS and 0.5 g/mL of $CsPbr_3$ nanocrystals. Figure 1 shows PL spectrum of $CsPbBr_3$ nanocrystals. The emission peak position is 518 nm under an excitation peaks at 365 nm. Figure 2 shows photograph of flexible scintillator composed of PDMS and $CsPbBr_3$ nanocrystals.

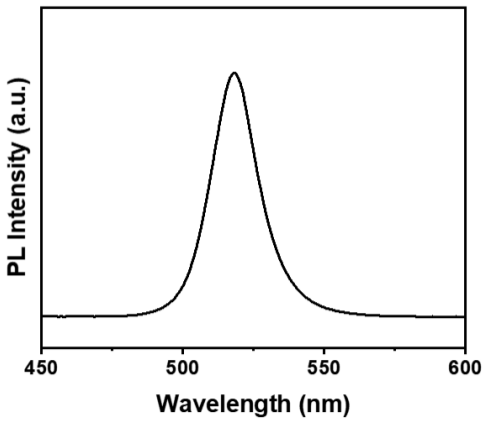

Fig. 1. PL spectrum of $CsPbBr_3$ nanocrystals..

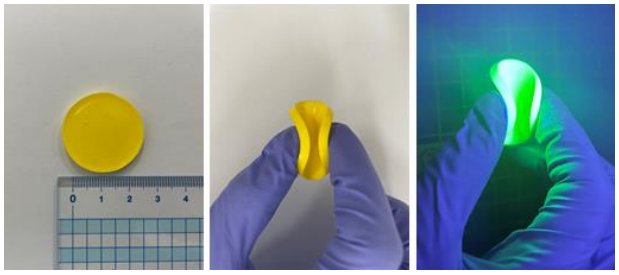

Fig. 2. Photograph of flexible scintillator composed of PDMS and CsPbBr3 nanocrystals..

2.2 Radioluminescence spectrum

Figure 3 shows schematic diagram of the experimental setup for the measurements of the X-ray induced radioluminescence. The X-rays with an intensity of 70 kV and a current of 25 mA are irradiated to the flexible scintillator composed of PDMS and $CsPbBr_3$ nanocrystals. Figure 4 shows radioluminescence spectrum. The flexible scintillator have emission peak of 518 nm, which is similar with PL spectrum of $CsPbBr_3$.

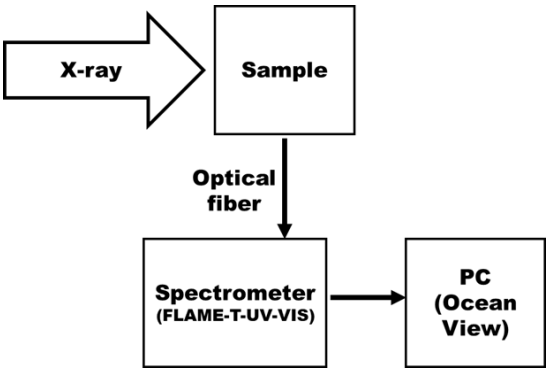

Fig. 3. Schematic diagram of the experimental setup for the measurements of the X-ray induced radioluminescence spectrum..

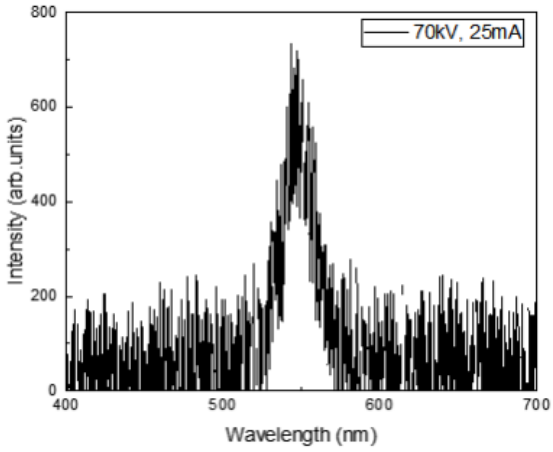

Fig. 4. Radioluminescence spectrum of flexible scintillator composed of PDMS and $CsPbBr_3$ nanocrystlas...

3. Conclusions

In this experiment, we measure radioluminescence of flexible scintillator composed of PDMS and $CsPbBr_3$nanocrystals. Because $CsPbBr_3$ nanocrystal have higroscopicity, their properties deteriorate when exposed to air. Thus the radioluminescence intensity of flexible scintillator is lower $CsPbBr_3$ nanocrystals. So, we have plan to improve the scintillating properties of the flexible scintillator by debugging fabrication methods of it.

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