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Tens nanometer scale cathodoluminescence bioimaging with rare-earth doped nanophosphors

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1. Introduction

Cathodoluminescence (CL) microscopy has a potential to visualize and distinguish specific kinds of biomolecules at higher spatial resolution than fluorescence microscopy imaging. Up to now, we have investigated multi-color CL observation with different kinds of rare-earth doped nanophosphors (NPs) [1, 2]. The previous results showed that small nanophosphors emit weak CL even though a few tens nm size of particles is indispensable for practical application. Therefore, the improvement of size and CL emission intensity are highly desired. We report the synthesis of highly emissive rare-earth doped NPs smaller than 50 nm and its CL imaging properties.

2. General Instructions

Synthesis of rare-earth doped nanophosphors

To synthesize luminescent NPs, we used urea-based homogeneous precipitation (HP) method [3]. HP method provides uniform and spherical phosphor nanoparticles with controllable synthesis conditions. Briefly, decomposition reaction of urea increases pH of solution and then the PH increase induces homogeneous precipitation of rare-earth occurs. Figure 1 shows the transmission electron microscopy image of synthesized Y_2O_3: Eu precursors. Precursor nanoparticles sized about 46.5 ± 6.4 nm (Fig. 1, Inset). To increase CL intensity, amount of Eu concentration was changed during the synthesis. After calcination, dispersed Y_2O_3: Eu NPs were obtained.

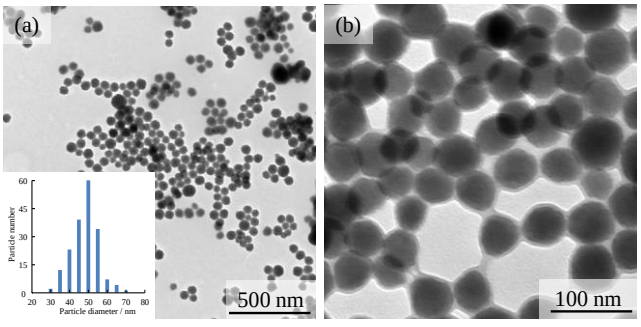

Fig. 1: Transmission electron microscopy images of Y_2O_3: Eu precursors synthesized by HP method. Inset; Size histogram of precursor nanoparticles.

Cathodoluminescence imaging of dispersed nanophosphors

Figure 2 shows SEM and CL images of synthesized Y_2O_3: Eu NPs. The images were obtained with a field emission scanning electron microscopy (FE-SEM; JEOL, JSM-6500F) and a CL measurement unit (HORIBA). The NPs were well dispersed and five Y_2O_3: Eu NPs were recognized in both FE-SEM and CL images.

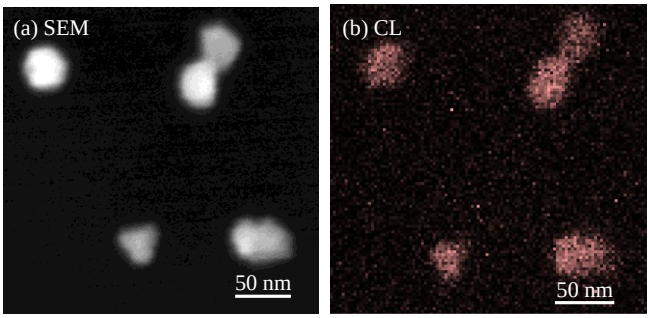

Fig. 2: (a) SEM and (b) CL images of Y_2O_3: Eu NPs. Accelerated voltage was 10 kV. Exposure time was 20 msec/pixel and wavelength of 613 nm.

3. Conclusion

We presented high luminescent NPs for high spatial resolution and multi-colored CL imaging. Less than 50 nm sized NPs were synthesized by HP method. The NPs were imaged with FE-SEM and a CL measurement unit.

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