Synthesis of Rare-earth Doped Nano Phosphors for Biological Cathodoluminescence Imaging

T. Furukawa¹, H. Niioka¹, M. Ichimiya¹², S. Ichikawa³, T. Nagata⁴, J. Miyake¹, M. Ashida¹, T. Araki¹ and M. Hashimoto¹
Graduate School of Engineering Science, Osaka University, 1-3 Machikaneyama, Toyonaka, Osaka 560-8531, Japan¹, Osaka Dental University², Institute for NanoScience Design Osaka University³, Tsukuba Institute for Super Materials, ULVAC Inc.⁴
E-mail: furukawa@sml.me.es.osaka-u.ac.jp

KEY WORDS: Cathodoluminescence, SEM, Nanophosphors, Rare-earth, Bioimaging

Cathodoluminescence (CL) imaging is promising imaging method which can realize identification of molecular species and high spatial resolution. Some researchers have demonstrated biological imaging with using CL [1-3]. The spatial resolution depends on size of phosphors due to nm order spatial resolution of CL microscope. In this research, nanophosphors for biological CL imaging were synthesized by enzymatic precipitation method, and we imaged the nanophosphors even though the size of nanophosphors was as small as about 50 nm.

Enzymatic precipitation method can produce a few tens to several tens nm precursors of phosphors because this method is able to control reaction activity of urea decomposition in room temperature with urease [4]. To obtain the phosphors with high crystallinity the precursors were annealed. This is because excited energy is lost at defects in phosphors and the phosphors with low crystallinity show weak CL intensity.

Figure 1 (a) – (b) shows TEM images of Y₂O₃:Eu nanophosphors synthesized by enzymatic precipitation method. The size of each aggregated phosphor was about 50 nm (Fig. 1 (a)), and its primary particles have high crystallinity because it has almost non-distorted lattice fringes (Fig. 1 (b)). CL intensity of the nanophosphor was bright enough to image, and spatial resolution of the CL image was comparable to the SEM image. For the future works, we will demonstrate CL imaging of cells using this phosphors and immunostaining method.

This research was partially supported by KAKENHI from the Ministry of Education, Culture, Sports, Science and Technology, Japan and Tateishi Science and Technology Foundation, Kyoto, Japan and Nakatani Foundation, Tokyo, Japan.

REFERENCES:

Fig. 1: TEM images of Y₂O₃:Eu synthesized by enzymatic precipitation method on carbon membrane Cu grid (Acceleration voltage: 200 kV).