Near-infrared Scintillation Properties of Nd-doped $CaZrO_3$ Crystals Grown by the Floating Zone Method

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With the advancement of near-infrared (NIR) photodetectors, typified by InGaAs photodiodes, near-infrared (NIR) -emitting scintillators have been actively investigated, extending beyond the conventional ultraviolet (UV) and visible (VIS) regions.

NIR-emitting scintillators have mainly been investigated in the aim of developing an optical-fiber-coupled remote monitoring system for high-radiation fields [1]. This currently investigated system employs an optical fiber with a length of tens to hundreds of meters, which is exposed to high doses of radiation. In those cases, the optical fiber is heavily damaged, and radiation-induced color centers are generated in them [2]. As the color centers severely hinder the transmission of UV–VIS light through the optical fiber, currently available scintillators, all of which emit UV–VIS photons, are inapplicable to this system. Therefore, developing novel NIR-emitting scintillators is in demand.

In this study, NIR scintillation properties of Nd-doped $CaZrO_3$ (CZO) crystal were investigated. Rare-earth (RE) -doped CZO phosphors have been well studied because of their excellent properties, such as high thermal and chemical stability [3]. While some RE-doped CZO phosphors have been reported to exhibit excellent emission properties, there have not been any report on photoluminescence properties of NIR-emitting CZO phosphors, let alone scintillation. Therefore, in this study, we synthesized CZO crystals doped with Nd^{3+}, which is well known for 1060 nm NIR emission, and investigated their photoluminescence and scintillation properties.

Figure 1 (a) shows the appearance of the 1% Nd-doped $CaZrO_3$ crystalline rods grown by the floating zone (FZ) method. They were transparent and slightly blue colored, possibly due to Nd^{3+} containing. Figure 1 (b) shows the X-ray induced scintillation spectrum of a rod. They exhibited scintillation in the NIR region, which originated from the $^4F_{3/2} \rightarrow {}^4I_J$ (J = 9/2, 11/2, and 13/2) transitions of Nd^{3+} [4]. More detailed discussion on the NIR photoluminescence and scintillation properties of the CZO crystals will be given on site.

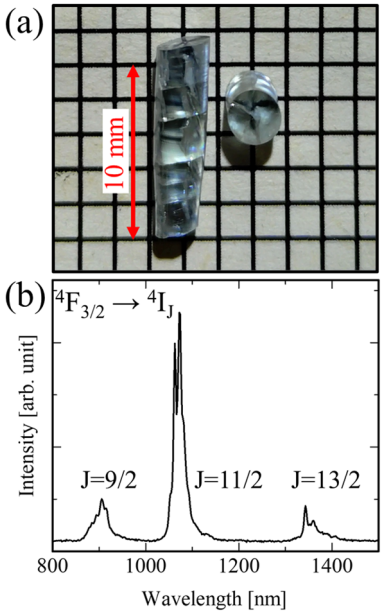

Figure 1 Appearance of the 1% Nd-doped $CaZrO_3$ crystalline rods grown by the FZ method (a) and the X-ray induced scintillation spectrum (b).

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3. A.K. Kunti et al., "Structural properties and luminescence dynamics of $CaZrO_3:Eu^{3+}$ phosphors" *Inorganic Chemistry Frontiers*, **8**, 821 (2020).
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