Scintillation of Al_2O_3 ceramic activated by Sc^{3+}

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Radiation monitoring has been a field of great interest for over years. Phosphor materials such as scintillators and dosimeters can be used to convert the ionizing radiation into low energy photons. The scintillators can conduct the conversions immediately whereas dosimeters accumulate the ionizing radiation energy for a period of time. Dosimeters needed external stimulation, either by heat (thermally stimulated luminescence, TSL) or by light (optically stimulated luminescence, OSL), to release the absorbed energy. Alumina (Al_2O_3) has been one of the phosphor materials that intensely studied. Al_2O_3 doped with carbon (C) has been established in personal dosimetry and been practically used as OSL dosimeters [1]. Furthermore, chromium (Cr) doped alumina, well known to give emission near infrared (NIR) region, is attractive in bio-imaging in addition to the ruby laser application. However, there still remains a large room for investigations by using Al_2O_3 as the host material.

In this study, we synthesized 1 mol% scandium (Sc) doped Al_2O_3 ($Sc:Al_2O_3$) ceramics by using Spark Plasma Sintering method (SPS). The sintering process was done in a vacuum atmosphere with a pressure of 7.8 kN at a sintering temperature of 1300 °C. A disk-shaped translucent ceramic with diameter of 10 mm was obtained. The aim of this study is to investigate radiation-induced properties for radiation measurements. Thus, characterizations were conducted including scintillation and photoluminescence (PL).

Fig. 1 shows the X-ray induced scintillation spectrum. A wide emission band was observed from about 280 nm to 500 nm due to F^+ and F centers [2]. Additional emissions were also observed with peaks at about 250 nm and 610 nm. Fig. 2 shows the scintillation decay curve which fitted approximately to one exponential decay function. Fast decay time constant of 1.06 μs was obtained. Further experimental results will be shown in the poster.

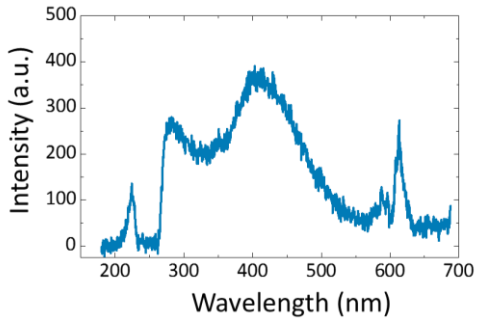

Fig. 1 Scintillation spectrum of $Sc:Al_2O_3$.

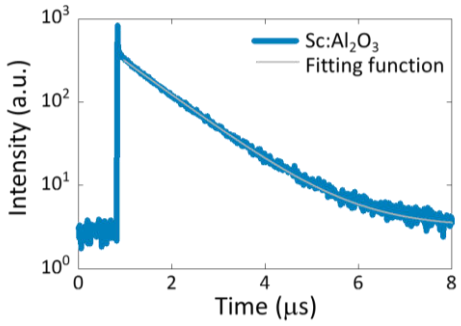

Fig. 2 Scintillation decay profile of $Sc:Al_2O_3$.

References:

[1] S. W. S McKeever et al., Rad. Prot. Dosi. 84 (1999) 163-168.
[2] Y. Futami et al., Rad. Meas. 55 (2013) 136-140.