

Recent Status of the Real-time Dose-Rate Monitor with Optical-Fiber and Red/Infrared Scintillator for the Decommissioning Step

Shunsuke Kurosawa¹, Akihiro Yamaji², Chihaya Fujiwara³, Shohei Kodama⁴

¹Nanosystem Integration Center, The University of Tokyo, Tokyo, Japan

²Research Center for Neutrino Science, Tohoku University, Sendai, Miyagi, Japan

³School of Engineering, Tohoku University, Sendai, Miyagi, Japan

⁴Graduate School of Science and Engineering, Saitama University, Saitama, Japan

Corresponding Author Email: kurosawa-@g.ecc.u-tokyo.ac.jp

Real dose monitors under the high-dose-rate condition are required to remove the debris in the Fukushima Daiichi Nuclear Power Plant in the early decommissioning steps. We have proposed a dose-rate monitor, named consisting of a scintillator, optical fiber, and photo detector as shown in Fig. 1. The scintillation materials are required to have long emission wavelengths (550 - 1000 nm) and high light output to avoid low transmission loss through the fiber and emission noise from the optical fiber itself (below 500 nm). Generally, light outputs for the scintillation materials are inversely proportional to the bandgap, and typically, iodides and bromides have narrow gaps compared to other materials such as chlorides.

We have developed several novel materials, such as Cs_2HfI_6 and Rb_2HfI_6 , for gamma-ray detection, and Li_2HfBr_6 is sensitive to both gamma rays and neutrons. Moreover, some oxide materials have relatively narrow gaps, and we focus on some garnet materials.

These scintillators had light outputs of 20,000 – 70,000 photons/MeV, and emission wavelengths of 600 to 750 nm. Using such scintillators, we succeeded in demonstrating the dose-rate monitoring system with a ^{60}Co source with an activity of around 100 TBq. Here, the measurement time of the one spot was less than 3 sec and the diameter of the fiber core was 0.6 mm. The dose-rate dynamic range was from 10 mGy to over 1 kGy, and our system was found to evaluate the wide dose-rate range in real-time. In this paper, we show the detail of the scintillation properties and some results of the survey of the decommissioning.

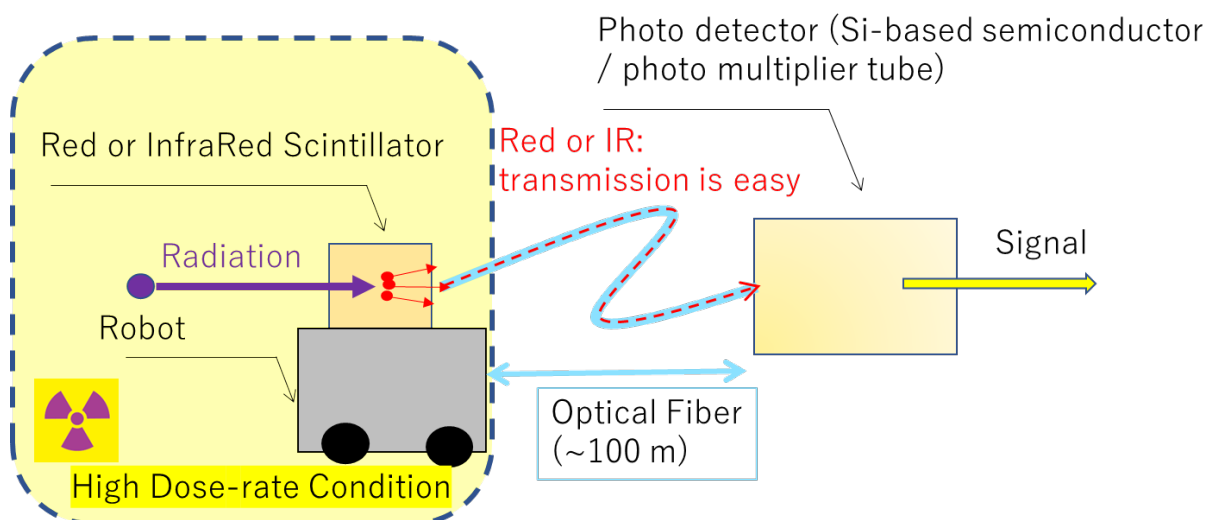


Fig. 1 Schematic view of our dose-rate monitor