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Estimation of dose linearity for halide scintillation detectors

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NaI(Tl) Scintillation detectors are widely used to measure the ambient dose equivalent rate for monitoring environmental gamma radiation. However, NaI(Tl) is limited to identify some gamma-rays from 131I, 134Cs, and 137Cs which are released from the nuclear facilities due to its low energy resolution. Three halide scintillation detectors –LaBr3(Ce), CeBr3, and SrI2(Eu) –were used to measure the ambient dose equivalent rate by measuring gamma-ray energy spectrum. Each scintillation detector was connected to a signal processing unit and the signal processing unit was optimized for pulse-shaping time. G(E) function method was applied to estimate the dose rate from the measured-gamma energy spectrum. Irradiation test was conducted with 137Cs source to each detector system. The exposure dose rate was in the range of 1 –100 μSv/hr. A 3”x3” NaI(Tl) scintillation detector was exposured to the irradiation test as a reference. The LaBr3(Ce) showed high dose linearity and energy resolution from low to high dose rate condition. The CeBr3 and SrI2(Eu) showed good energy resolution under 30 μSv/hr of ambient dose equivalent rate. From the result, the LaBe3(Ce) was applied to in situ gamma spectrometry system for monitoring environmental radiation near the Fukushima nuclear power plant.

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