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# Evaluation of Radon Suppression in Low Background Gamma-ray Spectroscopy Based on Monte Carlo Simulation Approach

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This study proposes the approach to remove the contribution of Rn-222 from the measured gamma-ray spectra, which achieved from a HPGe spectrometry. Several scenarios of flushing the central detector volume with nitrogen gas to actively remove the radon isotopes were simulated to evaluate the effect of Radon on the low-background gamma-ray spectra. To quantify the gamma background a set-up was prepared, the MCNPX code was adopted to evaluate the scenarios will be applied to the gamma-ray spectroscopy system consisting of a coaxial ORTEC HPGe detector (model number - GMX40-76) and the energy of events up to ~3 MeV at the NAA lab (KAERI, Republic of Korea). Rn-222 in the air around the detector contributes significantly to the remaining background and attention will be paid to the radon concentration, especially inside the sample chamber. The optimal configuration based on the simulations presented that a factor 4 improvement on the daughter decay peaks of Rn-222 with a ~30% reduction again in the integrated rate between 100-2700 keV to 0.751±0.001, and translating to improved sensitivity of the detector for the U-238 lines. The results also show a slight reduction in the 238 keV energy peak, more than expected from purging radon purely. This could be as a result of thoron reduction inside the main detector volume, which could explain why only the 238 keV peak was reduced and not the 338 and 911 keV peaks. Therefore, it can be concluded that the HPGe spectroscopy system at the NAA lab is fully operational and capable of making reliable measurements of sample activity with competitive sensitivity. It is now ready for use in material screening and selection for the environmental experiment.

Keywords: Radon, HPGe, MCNPX, Gamma-ray.

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