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Digital gamma-gamma coincidence HPGe system for environmental analysis

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Content

In order to decrease the detection limits for gamma-ray spectrometry it important to reduce the background. One of the promising techniques that may be used to accomplish this for coincident gamma emitters is gamma-gamma coincidence spectrometry. The progress of construction on the new coincidence spectrometer system installed at the Centre for Nuclear Technologies of the Technical University of Denmark and intended for environmental samples analysis is reported. Nutech Coincidence Low Energy Germanium Sandwich (NUCLeGeS) system consists of two Canberra (GL3825R) detectors placed in a surface laboratory in low activity lead shield and digital acquisition system used to collect the data in a time stamped list mode file with 10 ns time resolution. After the coincidence identification and basic data manipulation the spectrum is converted to .CAM format and GENIE2000 software is used for the further activity calculation. The capability of the new system is demonstrated in the case of multi-gamma emitters, 134Cs in the high 137Cs background, and single-gamma emitters, 210Pb in environmental samples. In the first case coincidence gated spectrum is extracted in order to reduce the background, while in later the coincidence spectrum was subtracted from the total for the Compton background removal. The system is compared to single HPGe gamma spectrometer of higher efficiency and to well-HPGe system with the NaI anti-Compton shield. Results are discussed in the scope of the optimum sample shape and size that can be used in the each system. Gamma-gamma coincidence spectrometry proved as the only effective way to reduce the 137Cs background in spectrometric determination of 134Cs, which is of importance in tracer applications in oceanography or to examine Chernobyl impact in environmental samples. The system also proved as effective in 210Pb determination, being able to accept bigger sample sizes than the well-shaped spectrometer and having greater efficiency and lower background in comparison to the single detector system.

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