PERFORMANCE EVALUATION OF A LANTHANUM BROMIDE SCINTILLATION DETECTOR FOR GAMMA-RAY ENERGIES UP TO 9 MeV

Abstract:
The Joint Research Centre of the European Commission develops instrumentation and analysis methods for non-destructive assay of nuclear materials and for detection of contraband materials. In relation to this, a new experimental device was designed and constructed in the laboratory of the Institute for the Protection and the Security of the Citizen (IPSC), Nuclear Safeguards Unit. The device, called the Pulsed Neutron Interrogation Test Assembly (PUNITA), incorporates a pulsed (D-T) neutron generator. In the PUNITA facility we study the methods applying the detection of characteristic gamma rays subsequent to neutron irradiation. This includes the detection of prompt gamma rays from neutron inelastic scattering and neutron capture. The gamma energy from these reactions is characteristic for the target elements present in the sample. The elements of our interest include oxygen, hydrogen, nitrogen, carbon, fluorine and chlorine emitting characteristic gamma ray energies in the range of 1 MeV to 11 MeV. For this purpose we are testing a scintillation detector based on the LaBr3:Ce crystal. This detector offers a substantial advantage over the standard NaI(Tl) detector: in comparison the energy resolution (about 3% at 662 keV) is better and the efficiency for high-energy gamma rays is higher. The work presented demonstrated the behavior (efficiency, linearity, energy resolution) of the 1.5\(\times\)1.5\(\times\)1.5 cm\(^3\) LaBr3:Ce crystal for gamma ray energies up to 9 MeV.

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