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Fusion Neutron Generator Dosimetry and Applications for Medical, Security, and Industry

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Abstract : Characterization and the applications of deuterium-deuterium (DD) neutron generator developed by Adelphie technology and acquired by the National Centre of Nuclear Science and Technology (NCNST) were presented in this work. We study the performance of the neutron generator in terms of neutron yield, production efficiency, and the ionic current as a function of the acceleration voltage at various RF powers. We provide the design and optimization of the PGNAA chamber and thus give insight into the capabilities of the planned PGNAA facility. Additional non-destructive techniques were studied employing the DD neutron generator, such as PGNAA and neutron radiography: The PGNAA is used for determining the concentration of 10B in Si and SiO2 matrices by using a germanium detector HPGe and the results obtained are compared with PGNAA system using a Sodium Iodide detector (NaI (Tl)); Neutron radiography facility was tested and simulated, using a camera device CCD and simulated by the Monte Carlo code; and the explosive detection system (EDS) also simulated using the Monte Carlo code. The study allows us to show that the new models of DD neutron generators are feasible and that superior-quality neutron beams could be produced and used for various applications. The feasibility of Boron neutron capture therapy (BNCT) for cancer treatment using a neutron generator was assessed by optimizing Beam Shaping Assembly (BSA) on a phantom using Monte-Carlo (MCNP6) simulations.

Keywords : neutron generator deuterium-deuterium, Monte Carlo method, radiation, neutron flux, neutron activation analysis, born, neutron radiography, explosive detection, BNCT
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