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Development of a Switchable Radioisotope Generator

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Alpha induced reactions are being implemented in the imaging and industrial fields. The alpha induced reactions will be implemented in those fields by the patent pending Switchable Radioisotope Generator (SRG). The SRG allows control over the alpha induced reactions by manipulation of the alpha producing material and the target isotope. To prove the effectiveness and practicality of the SRG, analytical calculations, simulations, and experimental measurements were conducted.

Activity estimations were conducted for 9Be and 10B, along with eight other materials, to find the highest reaction rate. This was to insure large error propagation would not occur when taking background radiation into consideration. 9Be was selected for alpha irradiation due to the high alpha capture cross section and low cost compared to other materials. Neutron Spectroscopy was used to determine the spectrum of neutron energy produced between 241Am and 9Be, with a preliminary measurement yielding a positive spectrum.

Simulations done in MCNP include the experimental setup to measure angular and energy dependence of neutrons. Cross section libraries were obtained through ENDF, then processed through NJOY in ACER format, such that they may be read into MCNP. MCNP6.1.1 Beta was used for initial simulation studies, but was found to process input files too slow. MCNP6.1.1 Beta was rebuilt and compiled through MCNP6 source code to enable Message Passing Interface (MPI), which allows for variance reduction by using multiple processors and faster processing times. The alpha source and target material geometry was defined in the MCNP input card, along with material compositions, data directories for the XSDIR file, and tallies for the energy and angular dependence of neutrons. The input cards were fed into MCNP6.2 using MPI. Preliminary results show a strong bias in forward scattering with energies ranging from 50-150 keV. Results from the final simulations were compared to the experimental data for conclusions and validation of the SRG.

The analytical calculations, experimental results, and simulation studies show how the SRG will function, and provide data validation for analytical calculations done in databases such as ENDF. The combination of the work performed will determine if the SRG is feasible in the imaging and industrial fields. The final results obtained from this project will determine if applications of the SRG will change.

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