AB002. Using Rutherford backscattering spectrometry for *in situ* characterization of boron neutron capture therapy lithium targets

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Background: The lithium target is an important component in accelerators used for boron neutron capture therapy (BNCT) and is necessary for the generation of neutrons in ^{7}Li(p,n)^{7}Be reactions. During operation, the lithium target is irradiated by a high-intensity proton beam with a power density of more than 250 W/cm^{2}. Protons produce radiation damage in the substrate material of the target known as blistering. Chemical reactions of lithium with residual gas, hydrogen, and substrate material are also possible. All of these phenomena can reduce the efficiency of neutron generation. The purpose of this study is to measure the amount of accumulated impurities in the lithium layer during irradiation of the lithium target with a high-intensity proton beam.
Methods: This paper describes the application of the Rutherford backscattering spectrometry (RBS) method to study changes in the composition of a lithium target. The feature of this work is that the RBS method was used *in situ*, i.e., utilizing the same proton beam for RBS as for neutron generation. The method was tested at the Virginia Innovative Traineeships in Accelerators (VITA) accelerator at Budker Institute of Nuclear Physics (BINP). Calculations of the backscattered proton spectra were performed using Simnra v.7.03 and were compared with measurements.
Results: A peak in the backscattered proton spectra associated with oxygen indicates that the thickness of the lithium oxide layer on the target surface gradually increased during operation. There were also indications within the spectra that the substrate material (copper in this case) penetrates into the lithium layer as the power density increases and the lithium melts. Neutron flux reduction due to the accumulation of impurities in the lithium layer was estimated using SRIM-2008.04 and compared with measurements.
Conclusions: The RBS method was applied for *in situ* characterization of BNCT lithium targets. The influence of lithium oxidation and melting on neutron generation was estimated and experimentally verified.
Keywords: Rutherford backscattering; lithium target; neutron generation

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study involved only physical experimentation on materials, without the use of human or animal subjects, and thus did not require ethical approval.

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