A Liquid Lithium Thin Film Stripper for RIA

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One of the challenges in the Rare Isotope Accelerator (RIA) driver and other high current heavy ion accelerators is to develop strippers that can withstand large power density deposited by the intense heavy ion beams. A liquid lithium stripper is considered a primary candidate for the first stripper in the RIA driver linac [1] because liquid lithium has good nuclear physics properties in stripping electrons at low energies and good thermal properties in removing very high heat loads while maintaining sufficiently low vapor pressure. The feasibility of using liquid lithium as a windowless liquid target for RIA was experimentally investigated recently at Argonne National Laboratory (ANL) and results showed the superiority of a liquid target concept over solid target concepts in high power accelerator applications. Good compatibility of a liquid lithium system with accelerator environments was also shown [2].

Acting on the promising windowless liquid lithium target results, a series of experiments was performed to investigate the feasibility of using a fast-moving liquid lithium thin film for the first stripper in th driver linac. Various preliminary experiments using simulants were first conducted to determine the film formation scheme, to investigate the film stability, and to obtain the design parameters for a liquid lithium thin film system. Based on the results from these preliminary studies, a prototypical, liquid lithium system was constructed to demonstrate liquid lithium thin film formation. This system was capable of driving liquid lithium at < ~300^{o} C at up to 13.9 MPa (2000 psia) through a nozzle opening as large as 1 mm (40 mil) in diameter. This drive pressure corresponds to a Li velocity of >200 m/s. A thin film of 9 mm in width at velocities of ~58 m/s was produced. Its thickness was estimated to be less than ~13 μm, see Figure 1. The pressure in the vacuum chamber, into which the Li thin film issued, remained below 10^{-5} Torr during the experiment.

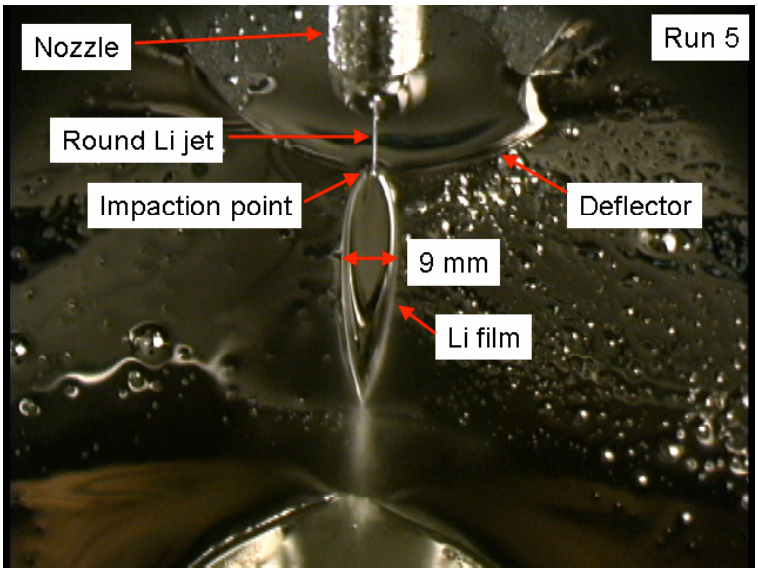

Figure 1. Photograph of a Liquid Lithium Thin Film.

[1] J.A. Nolen, "Overview of the US. Rare Isotope Accelerator Proposal," Nucl. Phys. A734, 661-668 (2004).

[2] Nolen, J. A., Reed, C. B., Novick, V. J., Specht, J. R., Bogaty, J. M., Plotkin, P., and Momozaki, Y., (2005) "Behavior of Liquid Lithium Jet Irradiated by 1 MeV Electron Beams up to 20 kW," Review of Scientific Instruments, vol. **76**, 073501.

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