DESIGN OF HIGH-POWER ISOL TARGETS FOR RADIOACTIVE ION BEAM GENERATION

G. D. Alton and Y. Zhang[1]
Physics Division, Oak Ridge National Laboratory,[2]
Oak Ridge, Tennesssee 37831-6368 USA

During the past few years, first generation ISOL facilities, such as the Holifield Radioactive Ion Beam Facility (HRIBF)[3,4], have provided first-ever opportunities for addressing fundamentally important questions in nuclear physics and nuclear-astrophysics, previously inaccessible to experimental study using stable-beam/stable-target combinations. However, the intensities of short-lived isotopes are limited by the production beam powers and energies available at first such facilities, and hence, second generation facilities such as the RIA[5,6] have been proposed that can deliver 1 GeV, 400 kW proton beams to production targets, thereby increasing RIB intensities. Unquestionably, target issues, related to the design of robust production targets with design features commensurate with the release of a broad spectrum of isotopes of a large number of elements that can withstand irradiation with light ion beams at power levels up to 400 kW for extended periods of time, *must* be developed for next generation facilities such as the RIA. Target requirements suggest selection of highly refractory target materials that can be formed into short-diffusion-length, integral, highly permeable (low-density) open structures. Targets that meet the fast diffusion release and effusive-flow criteria are necessarily fragile because of their low-density, low thermal-conductivity, low heat-capacity properties and can be easily destroyed by deposition of excessively high amounts of production beam power. Therefore, the irradiation process must be carefully managed to avoid exceeding the limiting temperature of the target material while homogeneously distributing the temperature over the volume of the target. In this report, we provide lists of refractory oxides, carbides and refractory metals and prescriptions for design and fabrication of custom engineered, fast diffusion release ISOL targets for producing short-lived proton-rich isotopes of elements (*He* through *Pu*) and neutron-rich isotopes of elements (*As* through *Dy*) for potential use at high-energy ISOL-based radioactive ion beam facilities such as the RIA. By utilization of beam manipulation techniques, in combination with placement of additional heat shielding on the exit end of targets, beam power depositional densities can be controlled and temperatures homogenized to acceptable levels within fast diffusion release, fast effusive-flow ISOL targets subjected to irradiation with 400 kW proton beams, as required at next generation radioactive ion beam facilities.

---

[1] Post Doctoral Fellow from the Chinese Institute of Atomic Energy, Beijing, China.

[2] Managed by UT-Battelle, LLC for the U. S. Department of Energy under contract DE-AC05-00OR22725.

[3] G. D. Alton and J. R. Beene, J. Phys. G Nucl. Part. Phys. 24 (1998) 1347.

[4] G. D. Alton, J. R. Beene, R. L. Auble and D. Stracener, Indian J. Phys. 76S (2002) 9.

[5] G. Savard, *Proceedings of the 2001 Particle Accelerator Conference*, IEEE: 01CH37268C (2001) 561.

[6] **http://www.nscl.msu.edu/future/ria**