The Production and Acceleration of Radioactive Ion Beams at the Holifield Radioactive Ion Beam Facility

G. D. Alton for the HRIBF Staff

Oak Ridge National Laboratory,[1] *P. O. Box 2008, Oak Ridge, TN 37831-6368*

E-Mail: gda@ornl.gov

Abstract

The Holifield Radioactive Ion Beam Facility (HRIBF) is a fully operational, first-generation national user facility based on the ISOL method for production and acceleration of radioactive ion beams (RIBs) for nuclear structure and nuclear astrophysics research. The facility utilizes a k = 100 cyclotron (ORIC) as a primary accelerator to irradiate targets with high-intensity light-ion beams (p, d, $^{3}He^{++}$ and $^{4}He^{++}$) from which radioactive nuclei are produced by fusion-evaporation and fission reactions, and a 25-MV tandem electrostatic accelerator for post-accelerating RIBs to research energies. Among several major challenging problems posed by generation of adequate RIB intensities for research using the ISOL method, target issues are arguably, the most daunting. The early successes of the HRIBF can, in part, be attributed to the successful development of a number of new and innovative, high-release-efficiency fusion-evaporation and fission-production targets as well as innovations in high-ionization-efficiency ion-source technology. As a consequence of these developments, more than 122 radioisotopes of 28 elements have been produced and efficiently released from specially designed targets and made available to the user community for research. To date, a number of important experiments have been performed at the HRIBF, including nuclear astrophysics experiments with proton-rich beams of ^{17}F, ^{18}F, at intensities for fully stripped $^{17}F^{9+}$ up to 3×10^{6}/s and nuclear structure experiments with ^{118}Ag at intensities up to 2×10^{6}/s. This report will principally be devoted to solutions of problems related to the efficient production, diffusion release, vapor transport, and ionization of short-lived isotopes that have been successfully employed at the HRIBF. In particular, the presentation will include information on: (1) the design and characterization of short diffusion-length, high-permeability fusion-evaporation and fission-production targets; (2) characterization of the effusive-flow properties of targets and vapor transport systems; and (3) the design of high-ionization-efficiency positive- and negative-ion sources.

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