On Line Yield Measurements of Actinide Targets

H. K. Carter[1], E. H. Spejewski[1], A. Kronenberg[1]
D. W. Stracener[2]
W. Talbert[3], H.-H. Hsu[3]
J. Nolen[4], J. Greene[4], T. Burtseva[4]

[1]Center of Excellence for Radioactive Ion Beam Studies for Stewardship Science, Oak Ridge Associated Universities, PO Box 117, Oak Ridge, TN 37831 USA
[2]Physics Division, Oak Ridge National Laboratory, PO Box 2008, Oak Ridge, TN 37831 USA
[3]TechSource, Santa Fe, New Mexico USA
[4]Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439 USA

The use of actinide targets with the isotope-separator-on-line (ISOL) technique for the production of neutron-rich nuclei has been used for many years at traditional ISOL facilities around the world. These facilities typically studied the radioactivity itself in decay-spectroscopy (stopped-beam) or low energy beam types of experiments. In recent years, the use of the ISOL technique has been applied extensively to provide a wide range of neutron-rich radioactive ion beams for acceleration in a subsequent accelerator. These so-called rare isotope accelerators set different requirements on the targets and ion sources than were previously required for traditional ISOL decay studies:

- For these new rare isotope accelerator facilities, the target typically must withstand considerably higher power from the primary beam.
- Typically, these facilities are interested in providing a wide variety of accelerated beams for the users.
- In many cases, for rare-isotope-accelerator type experiments, the accelerated beam should be "pure," i.e. contain essentially only one component.

While actinide targets, primarily UCx, have been used extensively in existing facilities, e.g. the Holifield Radioactive Ion Beam Facility (HRIBF) in Oak Ridge, their projected use in higher power facilities such as the proposed RIA facility in the United States, TRIUMF/ISAC in Canada and SPIRAL2 in France has prompted the reexamination of actinide targets with these new criteria. For a multipurpose facility, the last two requirements are often simultaneously a blessing and a curse. As often happens, the ideal solution is necessarily a compromise, e.g. a target with high thermal conductivity suitable for high power applications may not release the radioactivity with high efficiency.

The studies reported here are focused on the release properties of various actinide targets. Using the online isotope separator (UNISOR) at the HRIBF, we are studying the release properties of various actinide targets for the production of neutron-rich nuclei by proton-induced fission. By observing the decay gamma rays following online mass separation, we are able to measure the yields for each isotope. Using these yields and theoretical proton-induced cross sections, we are able to determine the combined target release and ion source efficiencies for each isotope. By measuring efficiencies for a number of different half lives of each element, we can deduce the holdup time for each element. We have also made direct measurements of the holdup time using the beam on/off technique.

These experiments have been repeated for a number of different target materials prepared by Oak Ridge National Laboratory and Argonne National Laboratory. The goal is to obtain experimental data that can be used together with simulations, such as with the code MCNPX, to predict efficiencies of release from other target configurations. Two-step, neutron-generator configurations will also be discussed.

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