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E. Reis1,2, V. Berlin2, S. Stegemann2, S. Bidhar3, D. C. Lupascu1, S. Rothe2

1Institute for Materials Science and Center for Nanointegration (CENIDE), University of Duisburg-Essen, Essen, Germany
2Center for European Nuclear Research, Geneva, Switzerland
3Fermilab National Accelerator Laboratory, Batavia, Illinois, USA
edgar.reis@cern.ch

At CERN-ISOLDE, over a thousand radioactive ion beams (RIBs) are produced from over 70 different types of target materials through the online isotope separation method (ISOL). The material is hit with a 1.4 GeV proton beam and undergoes nuclear reactions leading to the production and release of artificially created isotopes which are then ionized and extracted as ion beams.[1]
The design of target materials must therefore balance materials with high cross-sections for in-target isotope production and fast diffusion and effusion times for the produced and often short-lived species for delivery to ISOLDE experiments. This requires a compromise between density and pore structure, while keeping the required levels of thermal stability to limit sintering and maintain these properties in online operational conditions (which can reach upwards of 2000 C) accounting for power deposition from the incident proton beam, while avoiding chemical interactions which would prevent the isotopes of interest from being volatilized and extracted from the target, and suitable nuclear reaction pathways to create the desired isotopes.
Recent efforts were made to develop target materials with tailored microstructure and to study their characteristics with respect to isotope release, RIB yields and microstructural stability, focusing on ceramic materials which have proved particularly challenging to employ in the past such as zirconia and hafnia as they tend to fully sinter when heated inside an ISOLDE target[2]. and lanthanum or uranium carbides with improved isotope release properties. They are now being developed in-house by exploring different top-down and bottom-up techniques such as ball-milling, high-pressure precipitation and electrospinning [3] so that we can create materials with fewer contact points that are predicted to exhibit better resistance to sintering effects and continue to provide fast effusion paths for optimized extraction of difficult RIBs. In this contribution, we will give an overview over the past and on-going development efforts and present first results.

Keywords: radioisotopes, nanomaterials, electrospinning, nanofibers, ion beam production

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Author: SOBRAL DOS REIS, Edgar Miguel

Co-authors: CONSTANTIN LUPASCU, Doru (Institute for Materials Science and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen, 45141 Essen, Germany); ROTHE, Sebastian (CERN); Dr

STEGEMANN, Simon Thomas (CERN); BIDHAR, Sujit (Fermi National Accelerator Laboratory); BERLIN, Valentina (SY group)

Presenter: SOBRAL DOS REIS, Edgar Miguel

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