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Online prototype TiC-carbon nanocomposite target material: constant release properties and material development

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Highly porous nanograined materials have been developed throughout the last 10 years at ISOLDE-CERN, to deliver high and stable intensities of radioactive ion beams. The small grains provide short diffusion distances to the produced isotopes, while, after evaporation from the grain surface, the high porosity is beneficial for the isotope to escape the material envelope.

Embossed and rolled Ti metal foils of 30 μm thickness, have been used at ISOLDE to deliver beams of Sc, Ca and K. However, even though they provide good beam intensities in the beginning, their intensity rapidly decays over operation time. TiC is a highly refractory material with potential to become an ISOL nanometric material even though it has been discarded in the past in its 1-50 μm particle form.

Since nanometric TiC sinters at T>1500 ℃, TiC-C nanocomposites were developed to improve its stability, where C is either graphite, carbon black (CB) or multi wall carbon nanotubes (MWCNT). The selected nanocomposites were irradiated using the MEDICIS montrac system and studied for release using the solid state diffusion chamber at ISOLDE. TiC-CB presented the best release properties. This material was then upscaled to produce a full target and tested at ISOLDE as a prototype (#527) with a Re surface ion source.

The TiC-CB target release was tested from 1300 to 2000 ℃ showing improved yields of Na and Li in comparison with the best Ti foils target yields. However, lower yields on K and Ca were obtained, where we suspect that the CB may be hindering the release of these elements. Nonetheless, contrarily to Ti foils, the yields were stable during the full prototype operation period. An apparently longer release time-structure was observed for all isotopes as seen for other nanomaterials operated at ISOLDE.

The new TiC target provides improvements on some of the beams available for the physics program from the Ti-based target materials at ISOLDE. Nevertheless, an improved TiC-MWCNT nanocomposite has now been developed and waits prototype testing with the purpose of improving the n-def K and Ca yields, such as 35Ca and 35K.

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