COMPOSITE TARGET FABRICATION

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Efforts are presently underway at the HRIBF to develop universal, high-permeability matrices that can be coated with thin layers of any chosen target material to form short diffusion length targets for general use in the production of a wide-range of species for nuclear and astrophysics research at ISOL-based facilities, including the HRIBF. Since only a few materials can be procured in fibrous form (e.g., Al_2O_3, SiO_2, Y_2O_3, ZrO_2, HfO_2, CeO_2, Ta_2O_5, rare-earth-oxides) that are compatible in dimension and permeability for RIB target applications, it is highly desirable to find a universal, low-density, highly- permeable matrix for deposition of the target-material in a thin-layer format, optimally chosen in thickness so as to maximize the diffusion-release of the species in question when operated at the limiting temperature of the target-material. Furthermore, it is desirable that the matrix have good thermal conductivity attributes allowing the primary-beam deposited heat to be removed at a controlled rate so that, in combination, the target matrix can be operated at the maximum allowable primary beam intensity as dictated by the temperature limitation. Reticulated-vitreous-carbon fibers (RVCF) and carbon-bonded-carbon fibers (CBCF) offer highly permeable matrices for deposition of generic target materials onto their surfaces. Still other as yet untested materials, such a pitch-derived-carbon-foam (PDCF), are candidates for this application. CBCF is made of thin cylindrical fibers randomly glued together to form an open matrix. RVCF and PDCF are continuous ligament structures with respective tetra-kai-deca-hedron and spherical-void structures. These materials can be machined to the geometry desired for the particular target application prior to depositing the specified thickness of target material onto the surface. In cases where the target-material and C matrix will chemically react at elevated temperatures to form volatile compounds, such as would be the case for sulfides or oxides, the C-matrix must be pre-coated with a protective material such as Ta, W or Ir to prevent the undesired reaction. Techniques are presently available that can be used to uniformly deposit a specified thickness of the material in question onto the support matrix of choice. At this point in time, several target coating schemes are being used or are under consideration for this purpose, they include: (1) chemical vapor deposition (CVD); (2) physical vapor deposition (PVD); (3) electrolytic deposition (ED) and (4) sol-gel coating. Scanning-electron-micrographs (SEMs) of RVCF coated with thin layers of SiC, Ta and UC_2 are displayed in Figs. 1-3. The UC_2 targets, specifically prepared for the production of neutron-rich radio-nuclei for use at the HRIBF, have been tested at the

UNISOR facility and shown to have very good release properties. The results of these tests will be the subject of another contribution to this report.

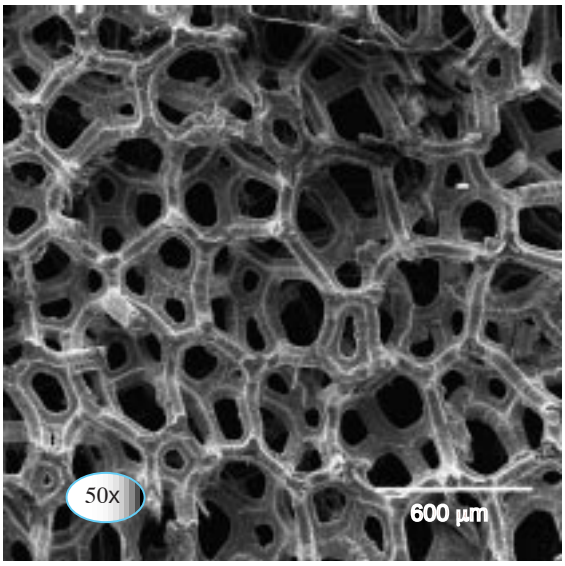

Fig. 1. Scanning-electron-micrograph (SEM) of SiC deposited onto reticulated-vitreous-carbon-fiber (RVCF) to form thin-layer, highly permeable targets for potential generation of ^{30}P and ^{30}S for use at the HRIBF.

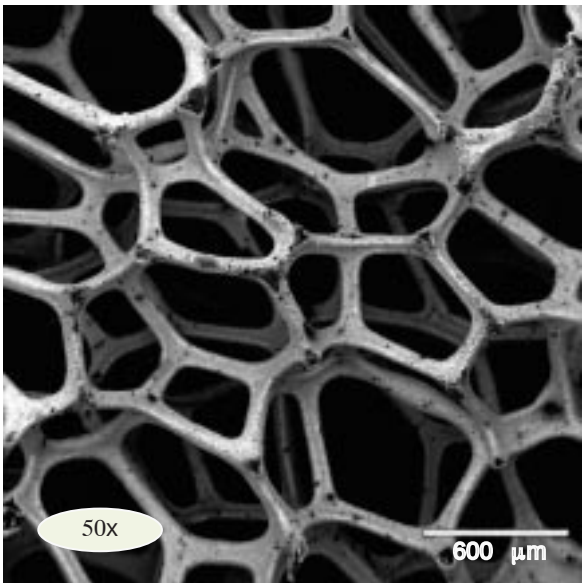

Fig. 2. Scanning-electron-micrograph thin layers of Ta deposited onto reticulated-vitreous-carbon-fiber (RVCF) to form thin-layer, highly permeable proton-rich targets for potential use of ISOL facilities with high-energy primary ion beams.

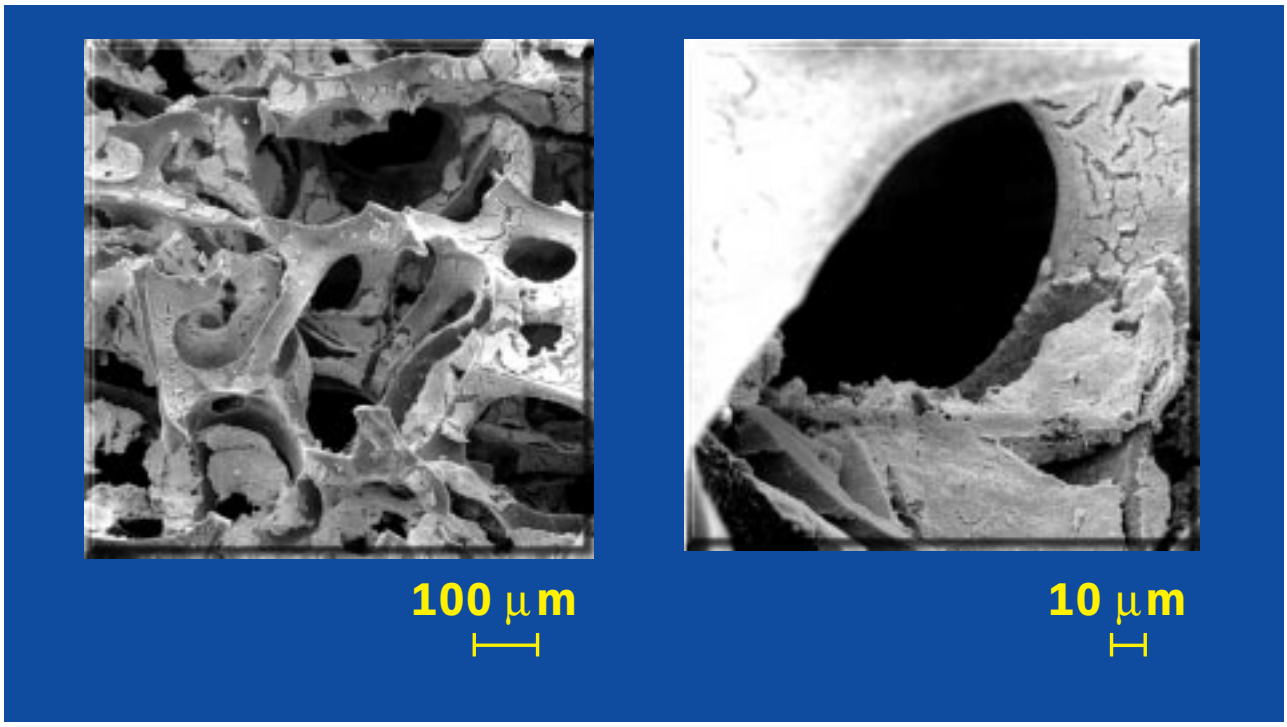

Fig. 3. Scanning-electron-micrograph (SEM) of UC_2 deposited onto reticulated-vitreous-carbon-fiber (RVCF) to form thin layer (~ 12 μm), highly permeable fission targets for future use at the HRIBF. These targets have been tested on-line at the UNISOR facility and shown to have very good diffusion-release properties for a wide variety of species.