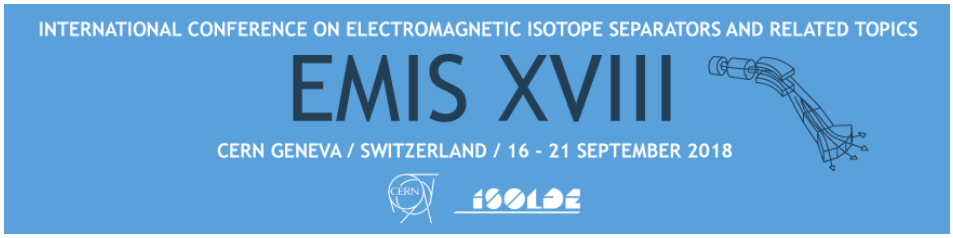


Contribution ID: **76** Type: **Invited**

# Thick solid targets for the production and online release of radioisotopes: the importance of the material characteristics

*Monday 17 September 2018 09:40 (30 minutes)*

In ISOL (Isotope Separator OnLine) facilities around the world, high-energy particle beams are accelerated towards a thick target to produce radioactive isotopes through nuclear reactions. Though different driver beam particles and energies can be used or converter targets (e.g. proton to neutron, electron to gamma) once the isotope of interest is produced in the main target, it has to be extracted from the target bulk. After thermalization the release from the target consists on diffusion out of the material crystal structure, through the material porosity and finally from the target material envelope to the ion-source. This phenomenon is highly dependent on the combination of matrix-element to be released, chemistry, microstructure and surfaces properties, which are all influenced by the operation temperature.

The chemical reactivity of the element of interest with the target material (contaminations or reactive gas introduced intentionally) and respective formed compounds play a substantial role. This created compound can either be a volatile molecule, which promotes release but might distribute the isotopes over different masses, or form a refractory compound which can partially or totally hinder the release. The surface properties, namely adsorption, play an important role after the isotope leaves the material bulk. The isotope atoms or molecules have to diffuse through the material porosity by colliding with the material pore surfaces and then the target structural materials until they reach the ion source, where sticking times and possible re-diffusion into the bulk are critical.
The microstructure characteristics (grain and pore size distributions, agglomeration factor, pore volume and resulting specific surface area) will have a large impact on the discussed phenomena, where the macrostructure is of relatively low importance. As such the engineering and high temperature stability (sintering, sublimation, phase change phenomena) of micro and nanostructures is of vital importance to any ISOL facility for the deliver exotic beams. To add to the complexity, these phenomena are in the presence of a high radiation environment where impurity and crystalline defect creation and annealing are a constant, where both have can change by orders of magnitude bulk diffusion rates (and implicitly sintering).

This talk will focus on the latest target related material developments mostly in terms of microstructure. It will also review and discuss the complex release phenomena and the influence of the material characteristics on it. The complexity of the release phenomenon make it nearly impossible to predict isotope yields through modeling, where the community highly depends on empirical data and extrapolations.

**Primary author:** Dr RAMOS, Joao Pedro (CERN)

**Presenter:** Dr RAMOS, Joao Pedro (CERN)

**Session Classification:** Session 1- Target and Ion Source Techniques

**Track Classification:** Isotope production, target and ion source techniques