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Molecular beams in the ISOL process

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Radioactive ion beam facilities exploiting thick targets, which are irradiated by a high-energy driver beam, allow the production of intense beams of many chemical elements. For example at CERN-ISOLDE more than 1000 isotopes of 73 different chemical elements are available for delivery to a large spectrum of experimental setups for investigations in nuclear physics, structure and applications.
While thick targets benefit from high in-target production rates, the release of the generated nuclides strongly depends on the chemical and physical nature of the element. Some elements (like Li, Na, K) are easily released. In contrast, it is still not possible to release many elements with high boiling points, the refractory metals (e.g. Mo, W, Os). The in-situ volatilization by molecule formation has proven to be a key concept for the extraction of such difficult elements [1].
Recently exotic boron beams could be newly produced upon injection of sulphur hexafluoride gas into a carbon nanotubes target [2]. Besides helping the volatilization of the isotope of interest , molecular beams can be used as a mean to purify from isobaric contaminations, as already shown for example for selenium beams, extracted as SeCO ions [3] or more recently also with germanium sulphide ions.
Within this contribution, we summarize novel developments in molecular beam formation and show an original target concept based on the fission recoil effect for the release and ionization of the most challenging refractory elements, which are still not available in any ISOL facility, despite of the long history of the technique. Detailled numerical and experimental data will be presented to prepare for an online prototype test.

References

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