Uranium Carbide Material Developments at CERN-ISOLDE

Summary of the presentation given on Monday 27 Jun 2011 at 16:00 (00h20')
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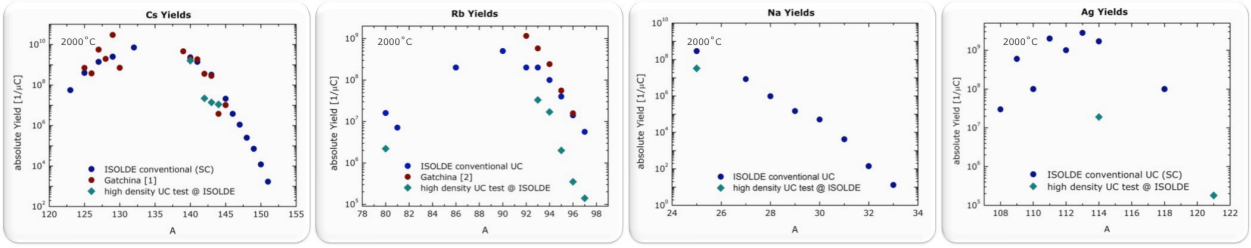
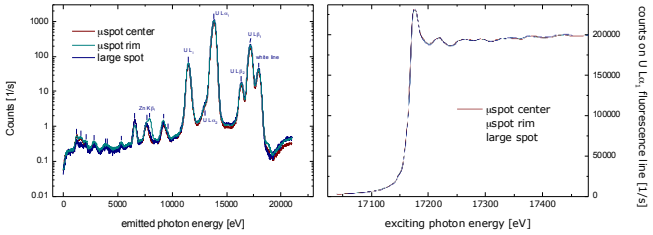
Abstract:
UCx targets have long been used in ISOL-type facilities to deliver a large range of different radioisotopes. Such targets are also central in the operation of next generation facilities, such as SPES, HIE-ISOLDE, SPIRAL2, and ultimately EURISOL. Within the FP7-ENSAR Joint Research Activity ActILab a large collaboration, including members from CERN, GANIL, INFN, IPNO and PSI, is working on novel and innovative technologies to further improve the performance of this promising target material. Activities at CERN involve the exploration of new kinds of material synthesis, online tests of recent types of actinide targets and finally comprehensive studies of structural, crystallographic and chemical evolution during target operation.

In 2009 more than 70% of the target units used for ISOLDE operation were UCx based. The strong interest in this particular target material arises from the large number of different isotopes strongly produced by CERN's high energy pulsed proton beam through fission, fragmentation, and spallation.
Although the success of this target material is unchanged throughout the last decades and its preparation has not been changed considerably, yet only little is known about the material's chemical and geometrical microstructure before and after irradiation and its contribution to the release properties.
In order to address these questions systematically the ActiLab collaboration was founded. In this framework a well-defined fine-grained Uranium Monocarbide with high density (12.7 g/cm^3) was studied online in a standard ISOLDE target geometry. The measured yields from the high density UC target at ISOLDE are comparable to the ones gained in Gatchina [1,2] after correcting for geometry and proton intensity. But despite its large thickness (241 g/cm^2) this target was found to deliver comparable absolute yields for the studied isotopes of Cs, Rb, Fr, K, Na, and Ag (partly shown in the charts below) compared to conventional ISOLDE UCx targets with smaller thickness (45 g/cm^2)[3]. This observation indicates, that in the case of the high-density material only a small fraction actually contributes to the release of isotopes.



To achieve better knowledge about the influence of the material's microscopic structure on the release properties advanced spectroscopic techniques are applied, both before and after proton irradiation while operation of the material in a target unit. In that way first tests using μ-spot extended X-ray absorption fine-structure spectroscopy have been successfully performed on the high-density material, reveling the chemical and crystallographic details on the μm-scale (see the X-ray fluorescence spectra (left) and the EXAFS spectra (right) below).



[1] V. N. Panteleev, *et al.*, Eur. Phys. J. A **42**, 495-501 (2009)
[2] V. N. Panteleev, EMIS-15, June 25, 2007
[3] ISOLDE Yield Database, http://oraweb.cern.ch/pls/isolde/querz_tgt, (25/05/2011)