Target-ion source unit ionization efficiency measurement by method of stable ion beam implantation

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The ionization efficiency is one of the most important parameters of an on-line target-ion source system exploited for production of exotic radioactive beams. The determination of the ionization efficiency as a characteristic of a target-ion source unit before on-line use is a very important step in the course of the preparation for an on-line experiment. At the IRIS facility (Petersburg Nuclear Physics Institute, Gatchina) a reliable and rather precise method for the measurement of the efficiency of the target-ion source unit by the method of stable beam implantation has been developed. The method exploits an off-line mass-separator for the implantation of the ion beams of selected stable isotopes of different elements into a tantalum foil placed inside the Faraday cup in the focal plane of the mass-separator. The amount of implanted ions is measured with a high accuracy by the current integrator connected to the Faraday cup. After the implantation of the required amount of the investigated species, the tantalum foil is implemented into the volume of the target-ion source unit prepared for the on-line utilization at the IRIS on-line separator. For the foil implementation the unit is equipped with a window, which is closed by a plug after the inserting the tantalum foil with the defined amount of atoms of the measured specimen into the target volume. The first tests with the method used have supplied the ionization efficiency values (90±20) % for Rb and (85±20) % for Cs in the empty combined target-ion source unit, which was used as a reference. For the combined target-ion source unit with UC target material inside prepared for an on-line experiment the measured value of the ionization efficiency was (52 ±20) %. A lower value can probably be explained by the carbonization of the inner surface of the target container that decreases its work function.