Construction of new experimental apparatus for astatine-211 production by a resonant laser ionization

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The feasibility study for the medical radioisotope: astatine-211 production by the gas cell-based laser ionization technique is ongoing.[1)] This method applies a physical separation instead of a chemical separation for extracting pure ^{211}At from the target, where ^{211}At is produced by the ^{209}Bi$(\alpha, 2n)^{211}$At nuclear reaction. It allows "isotope separation" during the isolation process, such as ^{211}At and ^{210}At. ^{210}At yields the undesirable α-particle emitting daughter, ^{210}Po. The applied physical separation comprises element selection by a resonant laser ionization and the mass selection by a quadrupole mass separation.

So far, a new laser system was built, as shown in Fig. 1. This pulsed laser system comprises different types of repetition rates: one dye laser at a low repetition rate of 50 Hz, pumped by excimer laser, and two dye lasers and one Ti:Sapphire laser at a high repetition rate of 10 kHz, pumped by two YAG lasers.

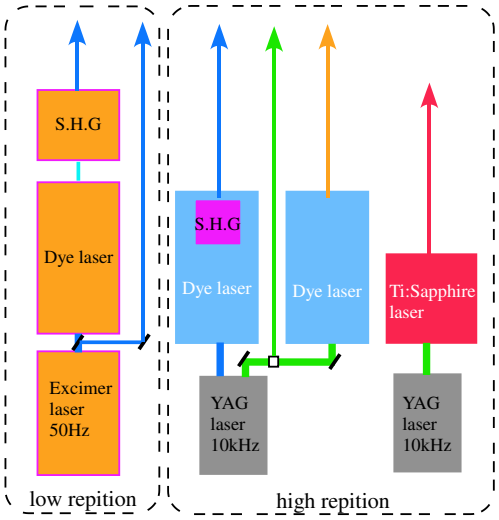

Fig. 1. The laser system for the resonant laser ionization of astatine-211.

Both types of lasers have a secondary harmonic generator for producing UV light, and the tuning range for wavelength lies on 210 to 900 nm. Four colors of laser beam can be produced simultaneously, in addition to two powerful laser beams split from a part of pump laser beams.

For the preliminary test, we constructed a simple ionization chamber where the photo-ionized atoms are produced by the evaporation of a filament in a vacuum. The evaporated atoms are ionized by laser beams and transported to the ion counter via a sextupole ion guide and an quadrupole mass separator. Figures 2 and 3 show the scan results for the wavelength and masses of stable copper isotopes, respectively.

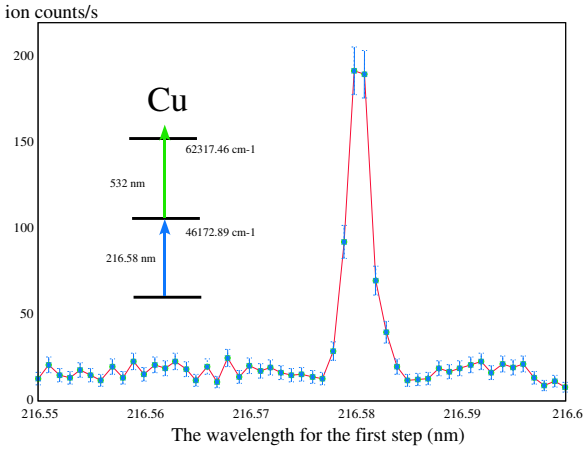

Fig. 2. The preliminary test result for the resonant laser ionization of stable copper isotopes in a vacuum: the ion counts versus the wavelength scan of the first step while the second step wavelength was fixed.

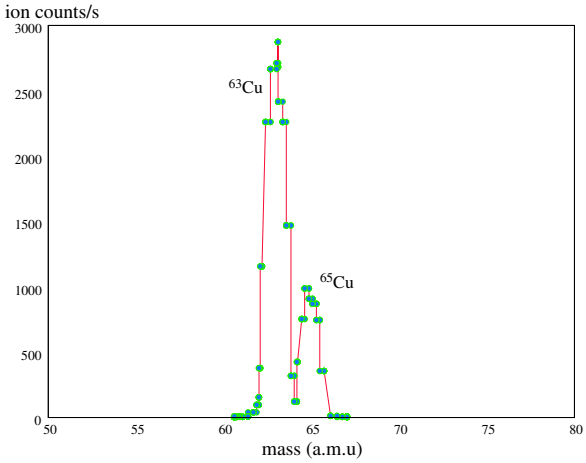

Fig. 3. The preliminary test result for the mass separation of photo-ionized stable copper isotopes: the ion counts versus atomic mass unit.

The construction of the laser system and the ionization test were successfully done. Next, we perform the laser ionization in gas cell for the efficient collection of ^{211}At.

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Reference

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