Production and Application of Radioisotopes using He Jet Transport System at RIKEN RI Beam Factory

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At RIKEN RI Beam Factory (RIBF), Wako, Japan, we have been developing production technologies of radioisotopes (RIs) and conducting RI application studies in the fields of physics, chemistry, biology, engineering, medicine, pharmaceutical and environmental sciences [1,2]. With light- to heavy-ion beams from the AVF cyclotron (AVF), we produce more than 100 RIs from ^{7}Be (atomic number $Z = 4$) to ^{262}Db ($Z = 105$). RIs of a large number of elements (multitracer) are simultaneously produced from metallic targets such as ^{nat}Ti, ^{nat}Ag, ^{nat}Hf, and ^{197}Au irradiated with a 135-MeV nucl.$^{-1}$ ^{14}N beam from RIKEN Ring Cyclotron [1,3]. The multitracer is useful to trace behavior of many elements simultaneously under an identical experimental condition.

Using Superconducting Ring Cyclotron and the fragment separator BigRIPS, RIBF can generate more than 3,000 RI beams with the world's highest intensity [4]. We propose to use these RI beams for application studies by implanting them into various materials such as water, acids, physiological saline, and pharmaceuticals [1]. One can select a radionuclide with suitable decay properties for its application. Since the RI beams are mass-separated from other fragments, they are very pure, and no or simple chemical separation is required for preparations of tracer solutions.

Element 113 was synthesized in the cold fusion reaction of ^{70}Zn on ^{209}Bi using the GAs-filled Recoil Ion Separator (GARIS) at the RIKEN linear accelerator facility [5]. In 2016, the name nihonium and symbol Nh were approved for the new element, the first element in Asia, by the International Union of Pure and Applied Chemistry [6].

Chemical characterization of newly-discovered superheavy elements (SHEs, $Z \geq 104$) is an extremely interesting and challenging subject in modern nuclear and radiochemistry. We installed a gas-jet transport system to GARIS as a novel technique for SHE chemistry [7]. SHE RIs of ^{261}Rf ($Z = 104$), ^{262}Db, ^{265}Sg ($Z = 106$), and ^{266}Bh ($Z = 107$) are produced in the heavy-ion induced reactions on a ^{248}Cm target [8–10]. The chemical synthesis and gas-chromatographic analysis of the first organometallic compound of SHEs, $Sg(CO)_6$ were successfully conducted [11]. A rapid solvent extraction apparatus coupled to the GARIS gas-jet system is under development for the first aqueous chemistry of Sg and Bh [12].

References

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