Nuclear chemistry research at IMP

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Research on the nuclear chemistry has been continuously conducted at IMP (Institute of Modern Physics, Chinese Academy of Science) for over 20 years. Remarkable achievements have been achieved from cutting-edge fundamental research on the chemical property of superheavy elements (SHEs) to advanced medical radioisotopes (RI) production and purification. Status and prospect of the SHE and RI study based on the HIRFL (Heavy Ion Research Facility in Lanzhou) will be presented in this work.

Platform for SHEs chemistry research coupled with the China Accelerator Facility for Superheavy elements (CAFE2) and the gas-filled recoil separator SHANS2 [1] has been constructed recently. Heavy ions of all species with a maximum energy of 7 MeV/u and mass-to-charge ratio A/Q=3 can be provided. Thin radio source [2], as well as targets of all lanthanide elements [3] and radioactive americium can be prepared in the local laboratory. The thermochromatography LEGEND system contained the classic silicon detectors and advanced 4H-SiC detectors [3, 4] and gas purification system were developed for the chemical investigation of Nh (Z=113). Investigation into Bh (Z=107) carbonyls is also scheduled for the upcoming research phase.

As the core of the nuclear medicine, medical RI have been profoundly embedded in multiple critical segments, including disease diagnosis, precision therapeutics, and healthcare security, thereby assuming an irreplaceable role in the global healthcare system [5]. At IMP, efforts are actively advancing technologies for the accelerator-based production of medical isotopes, including ^{99m}Tc/^{99}Mo, ^{68}Ge/^{68}Ga, ^{211}At, ^{225}Ac, ^{223}Ra, ^{212}Pb [6, 7, 8, 9]. The HIRFL can accelerate high energy hydrogen ions, providing a platform for researching on the production of ^{225}Ac. Building on this capability, the research team leveraged HIRFL's beam to bombard metallic ^{232}Th targets, generating ^{225}Ac through spallation reactions. In this experiment, an independently designed remote-controlled target-unloading robot was developed to upload and transport the high-radiation-dose ^{232}Th target. More importantly, about 40 µCi of ^{225}Ac was efficiently obtained using a self-developed fully automated multi-chromatography separation system with the recovery of 80%, radioactive nuclide purity exceeding 98%, radiochemical purity reaching over 99%, and chemical impurity content below 2.5 µg/mL.

References

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