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Isolation of At-211 by dry-distillation under oxidative conditions for targeted alpha therapy in Osaka University

Astatine (At)-211 is one of the most promising radionuclides for the targeted alpha therapy (TAT). In Osaka University, we have recently started the collaborative project for the TAT using ²¹¹At which can be produced in nuclear reactions using an accelerator. At present, cyclotron production, chemical separation, radiopharmaceuticals preparation, and pre-clinical trials of ²¹¹At are under study. In this contribution, our cyclotron production and chemical purification of ²¹¹At are presented.

Astatine-211 was produced in the ²⁰⁹Bi(α, 2n)²¹¹At reaction at Research Center of Nuclear Physics (RCNP), Osaka University. A thin metallic Bi target was bombarded by 28.2-MeV ⁴He²⁺ beam with 0.5-1 particle μA for a few hours. The Bi target was set at 45^o to the beam axis in an irradiation chamber. Beam energy was adjusted to avoid simultaneous synthesis of ²¹⁰At decaying into highly toxic ²¹⁰Po. After the irradiation, dry distillation was carried out with a simplified distillation apparatus to isolate ²¹¹At from the target materials . We used mixed helium and oxygen gas and also added a moisture content in the distillation system to yield oxidized At species which are easily transported, trapped, and dissolved in a small volume of distilled water. The irradiated Bi target was heated at 840^oC. Vapored At species were transported to a Teflon tube cooled with ice water. During accumulation of ²¹¹At in the trap, a trapped amount of ²¹¹At was monitored with a CdTeZn detector. After a few tens of minutes, trapped ²¹¹At was stripped with 100 μL of distilled water at a flow rate of 250 μL/min. The radioactivity of ²¹¹At was determined by γ-ray spectrometry using a Ge detector. The ²¹¹At solution was supplied to pharmaceutical preparations, pre-clinical tests, and/or our chemical analysis. Recovery yield of ²¹¹At was 70-80% under optimum conditions. The separation time was typically within 30 min. In the symposium, results on our chemical analysis will be also presented.

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