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Nuclear and radiochemical study of production and utilization of radioactive astatine isotopes in the 7Li+natPb reaction

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An alpha radioactive nuclide 211At with a half-life of 7.2 h is a prospective candidate for utilization in targeted alpha radiotherapy. In a general way, 211At is produced through bombardment of a bismuth target with 28 MeV helium ions in the 209Bi(alpha,2n)211At reaction because of the high yield required for therapeutic purpose [1]. However, the nuclear reactions using lithium ion beams, 6,7Li+Pb and 6,7Li+209Bi, provide the possible production routes of 211At. Excitation functions have been extensively measured for the 6,7Li+209Bi reactions to study the reaction mechanism involving complete fusion and breakup reaction of weakly bounded nuclei 6,7Li [2-4]. For 7Li+natPb, however, only reports on production of astatine isotopes 207-210At have been available for radiotherapy [5]. Therefore, we have measured excitation functions of 208-211At in the reaction of 29-57 MeV 7Li+natPb at the tandem accelerator of JAEA-Tokai. The cross sections of radioactive products were determined by alpha- and gamma-ray spectrometry. The cross sections of 211At below 45 MeV are large compared with those of the other astatine isotopes 208-210At. The experimental excitation functions of astatine isotopes have been compared with a statistical calculation to study the reaction mechanism. Besides, a chemical separation of carrier-free radioactive astatine isotopes from an irradiated target has been studied with a dry-chemistry method. Details will be shown in the presentation.

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