Production cross sections of (*d*,*x*) reactions on natural platinum†

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An accurate knowledge of nuclear reaction phenomena of light charged particles with platinum shows significance due to its various applications in science and technology. The microscopic experimental cross-sections of platinum are very useful for the production of medical radioisotopes, the verification of nuclear reaction theory, the thin layer activation analysis, etc. Recently, we investigated deuteron-induced reaction cross sections from various target elements because measured data of the (*d,x*) processes are limited compared to those of (*p,x*) processes. A survey of literature shows that several investigations have been conducted for the ^{nat}Pt(*d,x*) reactions leading to various applications. As an example, the production of the ^{198g}Au via the ^{nat}Pt(*d,x*) reaction finds applications in targeted radiotherapy and imaging procedures [1,2)]. Its half-life is suitable for an uptake and residence time of antibodies especially in the treatment of solid tumors without a significant loss of activity. Due to the monoisotopic characteristic of ^{197}Au target, the ^{197}Au(*n,γ*)^{198}Au reaction with a nuclear reactor of quite moderate power is currently being utilized as a commercial production route for ^{198}Au in many countries for clinical use [2)]. But the successive and simultaneous formation of ^{199}Au via the secondary ^{198}Au(*n,γ*)^{199}Au reaction is significant because of its very high cross-section, and therefore causes a small portion of ^{199}Au isotopic impurity and reduce the specific activity of ^{198}Au. Thus, measurements of new experimental cross-sections via the deuteron irradiation on natural platinum are expected to provide new production pathways for the no-carrier-added ^{198}Au.

The objective of the present study was to report the latest cross sections of the ^{nat}Pt(*d,x*)^{192,193,194,195,196m2,196,198m,198,199}Au, ^{195m,197}Pt and $^{190(g+m1+0.086m2),192(g+m1),194m}$Ir reactions that were measured with a high precision over the energy range of 2–24 MeV using the AVF cyclotron facility of the RIKEN RI Beam Factory, Wako, Japan. Details on the irradiation technique, radioactivity determination, and data evaluation procedures are available in Ref. [3)]. Owing to the space limitation of this report, we present only the ^{nat}Pt(*d,x*)^{198g}Au cross sections and the deduced yield in Figs. 1 and 2, respectively. Measured cross sections with an overall uncertainty are listed in Ref. [3)]. The cross-sections were normalized by using the ^{nat}Ti(*d,x*)^{48}V monitor cross sections recommended by IAEA. Measured data were critically compared with the available literature data and theoretical data, and only partial agreements were obtained with the earlier experimental and theoretical data extracted from the TENDL-2013.

The deduced thick-target yields indicate that a low amount of no-carrier-added ^{198g}Au could be obtained on an enriched ^{198}Pt (100%) target with the yield of 22 MBq/μA-h at 15 MeV deuteron energy from a cyclotron.

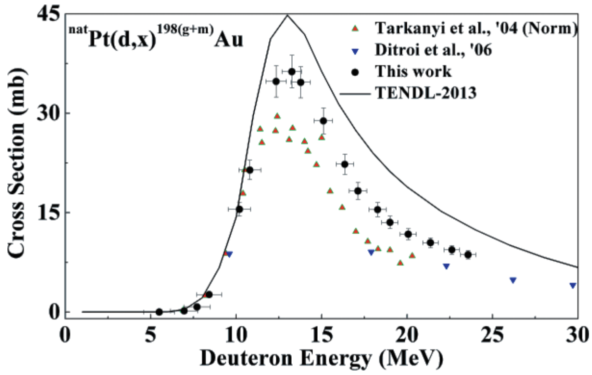

Fig. 1. Excitation function of the ^{nat}Pt(*d,x*)^{198g}Au reaction.

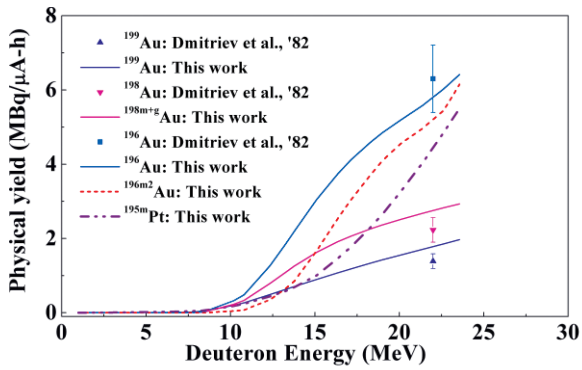

Fig. 2. Physical thick target yields for the $^{199,198g+m,196,196m2}$Au and ^{195m}Pt radionuclides.

References

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† Condensed from the article in Nucl. Inst. Meths. B. **362**, 151 (2015).

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