Fee-based activities performed by Nuclear Chemistry Group

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This article summarizes the fee-based activities performed by the Nuclear Chemistry Group in 2023, which include the distribution of radioisotopes (RIs) and utilization of heavy-ion beams in the industry.

Since 2007, RIKEN in collaboration with the Japan Radioisotope Association¹⁾ (JRIA) has distributed RIs to users in Japan for a fee. The nuclides include ⁶⁵Zn $(T_{1/2} = 244 \text{ d})$, ¹⁰⁹Cd $(T_{1/2} = 463 \text{ d})$, ⁸⁸Y $(T_{1/2} = 107 \text{ d})$, ⁸⁵Sr $(T_{1/2} = 65 \text{ d})$, and ⁶⁷Cu $(T_{1/2} = 61.8 \text{ h})$ produced in the RIKEN AVF cyclotron by the Nuclear Chemistry Group. Recently, we developed a production technology for ¹³⁹Ce $(T_{1/2} = 138 \text{ d})$ in the ^{nat}La(d, xn)¹³⁹Ce reaction for its distribution in 2024.²⁾

According to a material transfer agreement (MTA) between the JRIA and RIKEN, the JRIA mediates the transaction of RIs and distributes them to users. 65 Zn and ¹⁰⁹Cd are delivered approximately two weeks after an order is accepted. ⁸⁵Sr, ⁸⁸Y, and ⁶⁷Cu, which have short half-lives, are not stocked like ⁶⁵Zn and ¹⁰⁹Cd; instead, they are produced in a scheduled beamtime after an order is accepted. Therefore, they are delivered after two or more months. Details regarding RIKEN RIs can be found on the online ordering system, J-RAM,³⁾ of the JRIA. In 2023, we delivered one and three shipments of ⁸⁸Y and ⁸⁵Sr with total radioactivity of 0.1 and 13 MBq, respectively, whereas ⁶⁵Zn, ¹⁰⁹Cd, and ⁶⁷Cu had no orders. The final recipients of the RIs included two universities, one research institute, and one private company. Figure 1 shows the yearly trends of the number of orders and amount of distributed RIs. In comparison with 2022, in 2023, the amount of distributed 85 Sr increased to the second highest (13 MBq) since the beginning of its distribution, whereas the number of orders decreased. Both number of orders and amount of ⁸⁸Y increased.

In addition, we also provide ²¹¹At ($T_{1/2} = 7.2$ h) through MTAs drawn between Osaka University and RIKEN and between University of Tokyo, Saitama Medical University, and RIKEN. ²¹¹At is delivered to universities directly from RIKEN owing to its short half-life. In 2023, we delivered 7.0 GBq of ²¹¹At to Osaka University in 11 shipments and 100 MBq to the University of Tokyo in 2 shipments.

The Industrial Application Research Team of the Nuclear Chemistry Group promotes the utilization of heavy-ion beams in the industry. The RIKEN Nishina Center allows the use of the AVF cyclotron, RILAC2, and RIKEN Ring Cyclotron (RRC) by private companies in Japan for a fee.⁴⁾ Currently, the main users include semiconductor companies that irradiate spaceuse semiconductor devices with ⁴⁰Ar, ⁸⁴Kr, or ¹²⁹Xe ions from the RRC to simulate single-event effects due

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-Zn-65 20 Number of orders Cd-109 Y-88 Sr-85 - Cu-67 10 0 2006 2010 2014 2018 2022 Year 150 -Zn-65 Amount (MBq) Cd-109 Y-88 100 Sr-85 - Cu-67 50 0 2006 2010 2014 2018 2022 Year

Fig. 1. Number of orders (upper) and amount (lower) of RIs distributed annually from 2007 to 2023. Distributions of ⁸⁸Y, ⁸⁵Sr, and ⁶⁷Cu started in 2010, 2015, and 2018, respectively.

to the heavy-ion components of cosmic radiation.

The proposals for beam utilization are reviewed by a program advisory committee dedicated to industrial use (In-PAC).

In January 2023, In-PAC held its 20th meeting where it reviewed and approved five proposals. In July, In-PAC held its 21st meeting, where it reviewed and approved seven proposals, including one new proposal.

In 2023, seven companies executed 33 fee-based beamtimes, 17 of which used a 84 Kr beam, 9 utilized an 40 Ar beam, 6 utilized a 129 Xe beam, and one utilized a 12 C beam with total beam times of 235, 124, 67, and 7 hours, respectively.

References

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