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Excitation functions for production of rutherfordium isotopes in the $^{248}\text{Cm} + ^{18}\text{O}$ reaction

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Rutherfordium-261 (^{261}Rf ; $T_{1/2} = 68\text{s}$) has been used in chemical studies of element 104, Rf [1]. In recent years, it was reported that there exists a spontaneously-fissioning (SF) isomer (^{261}bRf ; $T_{1/2} = 2.6\text{s}$) in ^{261}Rf [2-6]. On the other hand, a SF isomer with the similar half-life of 2.1 s also had been reported as ^{262}Rf ($T_{1/2} = 47\text{ms}$) [7,8]. It is possible that these two SF isomers are the same and one of these is misassigned. In this work, the excitation functions of Rf isotopes in the $^{248}\text{Cm} + ^{18}\text{O}$ reaction were measured to clarify the ambiguity on the assignment of the fissioning isomers in $^{261,262}\text{Rf}$ [9]. Rutherfordium isotopes were produced by bombarding the ^{248}Cm target with an ^{18}O beam supplied from the RIKEN linear accelerator. The beam energies were 88.2, 90.2, 94.8, and 101.3 MeV at the center of the target. A gas-filled recoil ion separator (GARIS) was used to separate the evaporation residues (ERs) in-flight from the incident particles and majority of by-products. ERs were then implanted into a position-sensitive Si strip detector mounted at the focal plane of GARIS. The beam on-off method was applied to measure the decay events of Rf isotopes under low background conditions. At each beam energy, beam on-off periods were set to 6 s-6 s and 0.1 s-0.1 s. The shape of the measured excitation function of ^{261}aRf agreed with the previously reported one [10]. The excitation function of a-few-second SF nuclide exhibited the maximum cross section at 94.8 MeV, and the shape of the excitation function was almost the same as that of ^{261}aRf . On the other hand, short-lived SF decays were observed at 88.2 MeV and 101.3 MeV, and they were assigned to ^{262}Rf and ^{260}Rf , respectively. Such the short-lived SF decay was not observed at 94.8 MeV. Therefore, we concluded that a-few-second SF nuclide previously assigned to both ^{261}bRf and ^{262}Rf is not ^{262}Rf but ^{261}bRf .

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Primary author: Mr MURAKAMI, Masashi (Nishina Center, RIKEN)

Co-authors: Dr YONEDA, Akira (Nishina Center, RIKEN); Dr KAJI, Daiya (Nishina Center, RIKEN); Prof. KIKUNAGA, Hidetoshi (Tohoku University); Mr MURAYAMA, Hirohumi (Niigata University); Dr HABA, Hiromitsu (Nishina Center, RIKEN); Prof. KUDO, Hisaaki (Niigata University); Prof. MORITA, Kosuke (Nishina Center, RIKEN); Dr MORIMOTO, Kouji (Nishina Center, RIKEN); Prof. GOTO, Shin-ichi (Niigata University); Dr SUMITA, Takayuki (Nishina Center, RIKEN); Dr SATO, Tetsuya (Japan Atomic Energy Agency); Dr KASAMATSU, Yoshitaka (Osaka University); Dr KUDOU, Yuki (Nishina Center, RIKEN)

Presenter: Mr MURAKAMI, Masashi (Nishina Center, RIKEN)

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