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Synthesis of new elements using dynamic effects of nuclear structure in fusion fission processes

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At present, the research into the synthesis of superheavy elements is being pursued under two main goals. One goal is to synthesize elements with larger atomic numbers, and the other is to reach Island of Stability predicted as the next double magic nucleus. The periodic table is currently marked up to element 118, Oganesson (Og) [1], and experiments are being conducted with the aim of synthesizing element 119 as the next new element. Recently, a successful synthesis experiment (54Cr + 238U → 292-xLv) has been carried out using a Cr beam [2].

Here, we discuss the methods using secondary beams with neutron rich nuclei. In the method using a secondary beam, there are concerns about whether a measurable evaporation residual cross section can be obtained because the beam intensity is very small.
However, theoretical analysis suggests that a large evaporation residue cross section can be obtained from the mechanism of the fusion process by the neutron-rich beam and the mechanism of the decay process of the produced nuclei, and that the advantage is sufficient to compensate for the disadvantage of the beam intensity. In this talk, we will explain and verify the mechanism and discuss the possibility of synthesizing new elements using the secondary beam.

The dynamical and statistical models are used to calculate the production of compound nuclei in the neutron-rich region, their decay processes and to evaluate the evaporation residue cross-sections. To produce neutron-rich compound nuclei, as well as future experimental plans, including the advantage of survival probabilities, are discussed [3]. The possibility of synthesizing new elemental syntheses, exploiting “the dynamic effects of the shell structure”, will be discussed.

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References

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