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Theoretical estimation and reaction mechanism of synthesizing neutron rich nuclei in superheavy mass region

Research on neutron-rich nuclei in the heavy and superheavy mass region is gaining importance in the fields as the synthesis of new elements [1,2,3], the r-process and multi-nucleon transfer reactions. Furthermore, the use of neutron-rich nuclei is indispensable for reaching the Island of Stability [4] that are predicted to exist in the superheavy element region, and the evaluation of the generation probability of neutron-rich nuclei is necessary.
To success the synthesis of superheavy elements, we must clarify the fusion-fission mechanism, which is included a role of the nuclear structure of colliding nuclei and the deformation of them in the fusion process. We calculate the probability of forming a compound nucleus using Langevin equation as the dynamical model [5]. We discuss the possibility to synthesize new elements $Z \geq 119$. Moreover, to approach to the Island of Stability, we propose the new way using the shell effect during the dynamical process.
To estimate the evaporation residue cross section, we must calculate the survival probability of the excited compound nuclei, in the decay process. At present, the statistical model is used as standard to evaluate the survival probability [6]. When dealing with very small probabilities, and because of the computation time, the use of the statistical mode is suitable.
However, in the neutron-rich nuclei in the superheavy mass region, we find that the inconvenience appears in the calculation of the statistical model code. In the code, we use the mass table by P. Moller [7], and there are cases where the ground state shell-corrected energies in these regions are close to zero or even positive. In the statistical model, the finite height of the fission barrier and the ability to define the saddle point are the basis of the theory construction. In this situation, it may not be applicable to nuclei without a fission barrier. In this research, we discuss based on these analyses, and discuss the introduction of a dynamical model and the modification of the mass table as solutions to the problem.

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