Study of isotopic yield and half-life of spontaneous fission for two $^{266}_{104}Rf$ and $^{268}_{104}Rf$ superheavy isotopes

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Abstract

Isotopic yields and half-lives for $^{266}_{104}Rf$ and $^{268}_{104}Rf$ isotopes of the superheavy nucleus Rutherfordium are calculated and compared with the experimental data. For each fragmentation, the probability of tunneling through the fission barrier and the fission decay constant are obtained using the WKB approximation. Then, by summation over all partial fission constants, total fission constant and half-lives of two isotopes are obtained. In order to calculate the fission barrier, proximity nuclear and Coulomb potentials are considered (because of even-even isotopes, their ground state spin is zero, so centrifugal potential becomes zero.). The fission barrier as a function of fragment mass number is plotted for two isotopes. Usually, spontaneous fission occurs in superheavy nuclei in such a way that the excitation energy of the parent nucleus is low and therefore the number of neutrons emitted along with the fission is small and can be ignored. Therefore, in this method, which is known as cold spontaneous fission, instantaneous emission of neutrons along with fission is ignored. Isotopic yields of $^{266}_{104}Rf$ and $^{268}_{104}Rf$ for all possible splitting indicated that the production of two fragments $^{134}_{52}Te$ and $^{132}_{52}Te$ have the highest partial yields for fission of $^{266}_{104}Rf$ and $^{268}_{104}Rf$ isotopes, respectively. The existence of a small difference between the calculated and measured half-lives confirms the relative success of our method.

Keywords: spontaneous fission, isotopic yield, superheavynuclei, half-life, potential barrier

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