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Synthesis of Deformed Nuclei 260Rf, 261Rf and 262Rf in the Decay of 266Rf*Formed via Different Fusion Reactions: Entrance Channel Effects

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Abstract : Relatively long-lived transactinide elements (i.e., elements with atomic number Z≥104) up to Z = 108 have been produced in nuclear reactions between low Z projectiles (C to Al) and actinide targets. Cross sections have been observed to decrease steeply with increasing Z. Recently, production cross sections of several picobarns have been reported for comparatively neutron-rich nuclides of 112 through 118 produced via hot fusion reactions with 48Ca and actinide targets. Some of those heavy nuclides are reported to have lifetimes on the order of seconds or longer. The relatively high cross sections in these hot fusion reactions are not fully understood and this has renewed interest in systematic studies of heavy-ion reactions with actinide targets. The main aim of this work is to understand the dynamics hot fusion reactions 18O+ 248Cm and 22Ne+244Pu (carried out at RIKEN and TASCA respectively) using the collective clusterization technique, carried out by undertaking the decay of the compound nucleus 266Rf∗ into 4n, 5n and 6n neutron evaporation channels. Here we extend our earlier study of the excitation functions (EFs) of 266Rf∗, formed in fusion reaction 18O+248Cm, based on Dynamical Cluster-decay Model (DCM) using the pocket formula for nuclear proximity potential, to the use of other nuclear interaction potentials derived from Skyrme energy density formalism (SEDF) based on semiclassical extended Thomas Fermi (ETF) approach and also study entrance channel effects by considering the synthesis of 266Rf* in 22Ne+244Pu reaction. The Skyrme forces used are the old force SIII, and new forces GSkI and KDE0(v1). Here, the EFs for the production of 260Rf, 261Rf and 262Rf isotope via 6n, 5n and 4n decay channel from the 266Rf∗ compound nucleus are studied at Elab = 88.2 to 125 MeV, including quadrupole deformations β2i and 'hot-optimum' orientations θi. The calculations are made within the DCM where the neck-length ΔR is the only parameter representing the relative separation distance between two fragments and/or clusters Ai which assimilates the neck formation effects.

Keywords : entrance channel effects, fusion reactions, skyrme force, superheavy nucleus
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