Study of Decay properties of $^{269-271}$Hs* nucleus formed via Different incoming Channels by using GSkI Skyrme Force

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Introduction

The occurrence of superheavy nuclei is due to the quantum shell effect that overcomes the strong Coulomb repulsion between the large numbers of protons and stabilized them against spontaneous fission. In the present work, we extend our earlier [1] study of the excitation functions (EFs) of $^{274}$Hs*, formed in fusion reactions $^{26}$Mg+$^{248}$Cm, $^{48}$Ca+$^{226}$Ra and $^{30}$S+$^{238}$U, based on Dynamical Cluster-decay Model (DCM) [2], to the use of other nuclear interaction potential derived from Skyrme energy density formalism (SEDF) based on semiclassical extended Thomas Fermi (ETF) approach. The Skyrme force used is the new GSkI force [3] for our calculation. The radius vectors for axially symmetric deformed nuclei are

$$ R_i(\alpha_i, T) = R_{0i}(T) \left[1 + \sum_\lambda \beta_\lambda Y_\lambda^0(\alpha_i) \right], \quad (2) $$

with T-dependent equivalent spherical nuclear radii $R_{0i}(T) = R_{0i}(T = 0)(1 + 0.0007 T^2)$ [8] for the nuclear proximity pocket formula, and $R_{0i}(T = 0)(1 + 0.0005 T^2)$ [9] for SEDF, where $R_{0i}(T = 0) = [1.28 A_i^{1/3} - 0.76 + 0.8 A_i^{-1/3}]$.

Finally, the compound nucleus temperature $T$ (in MeV) is given by

$$ E^* = E_{c.m.} + Q_{in} = (A/10) T^2 - T. \quad (3) $$

Adding to $V_N$, the Coulomb and angular momentum $\ell$-dependent potentials $V_C$ and $V_\ell$, we get the total interaction potential $V(R, \ell)$, characterized by barrier height $V_B$, position $R_B^\ell$ and curvature $h\omega_\ell$, each being $\ell$-dependent.

The compound nucleus decay/ fragment formation cross sections are calculated within the DCM, given as

$$ \sigma = \frac{\pi}{k^2} \sum_{\ell=0}^{\ell_{max}} (2\ell + 1) P_0 P; \quad k = \sqrt{\frac{2\mu E_{c.m.}}{h^2}} \quad (4) $$

where $P_0$ is preformation probability referring to mass asymmetry $\eta = (A_1 - A_2)/(A_1 + A_2)$.

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Calculations and Results

Fig.1 (a) shows the comparison of experimental 3n to 5n evaporation channel cross section (σ_{3n-5n}) lines denote theoretical results and symbol denotes experimental results) for the fusion reactions $^{248}\text{Cm}$($^{26}\text{Mg},5n$-3n)$^{269-274}\text{Hs}$, $^{226}\text{Ra}$($^{48}\text{Ca},4n$)$^{274}\text{Hs}$ and $^{238}\text{U}$($^{36}\text{S},4n$)$^{274}\text{Hs}$ with the calculations made for the included DCM GSKI Skyrme force. (b) The best fitted $\Delta R$ values obtained for 3n to 5n evaporation cross section from CN $^{274}\text{Hs}$ as a function of energy.

motion and $P$, the penetrability, to R motion. For further details, refer to [2, 10].

References