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Fission decay modes of 254Fm* compound nucleus formed in 16O+238U reaction

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A thorough understanding of nuclear fission is still an arduous task due to its sudden transition from asymmetric to symmetric division, especially in the actinide mass region (near A=254 to 258). Recently, an attempt has been made to see the effect of compact and elongated configurations of quadrupole (β2) deformed decay fragments on the spontaneous fission of 242-260Fm isotopes using preformed cluster model [1]. It has been observed that tip-to-tip (elongated) configuration results in the production of double-peaked (asymmetric) to triple-humped (multimodal) fission fragment mass distribution with an increase in neutron number of Fm isotopes. In the present work, Quantum mechanical fragmentation theory (QMFT) [2] based dynamical cluster-decay model (DCM) [3] is applied to analyze the possibility of multimodal fission modes of excited 254Fm*compound nucleus produced in 16O+238U nuclear reaction. The calculations are made at center-of-mass energy Ec.m.≈ 84 MeV near the Coulomb barrier by considering T-dependent β2-deformed compact as well as elongated configurations with optimum orientations. The competitive emergence of different symmetric [symmetric superlong (SL), symmetric supershort (SS)] and asymmetric [standard 1 (S1), standard 2 (S2), standard 3 (S3), superasymmetric (SA)] fission modes has been explored by studying the fragmentation potential and multi-humped peak of preformation yield P0 of 254Fm.* The division of mass and charge in nuclear fission of 254Fm* depicts the importance of spherical and deformed magic shell closures. The most energetic light (AL) and heavy (AH) decay fragments of aforementioned fission modes are identified. Moreover, the DCM-calculated fission cross-section and other depicted results show reasonable agreement with the experimental measurements of Ref. [4].

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