

Fusion Reactions at Low Bombarding Energies

Authors : Nitin Sharma, Rahbar Ali, Dharmendra Singh, R. P. Singh, S. Muralithar, M. Afzal Ansari

Abstract : Heavy ion-induced reactions have gained significant attention in nuclear physics due to their potential to elucidate reaction mechanisms and explore practical applications. Hence, the present simulation work has been done with a projectile of ^{12}C on $^{142,146}\text{Nd}$ target at beam energy ranging from 4-7 MeV/nucleon. In the present work, measurement of excitation functions of evaporation residues produced via CF and/or ICF in the system $^{12}\text{C} + ^{142,146}\text{Nd}$ has been done. The evaporation residues ^{150}Dy (4n), ^{149}Dy (5n), and ^{149}Tb (p4n) are populated via xn/pxn emission channels and $^{147,146}\text{Gd}$ ($\alpha 3\text{n}/\alpha 4\text{n}$) via αxn emission channels in $^{12}\text{C} + ^{142,146}\text{Nd}$ system, confirmed by statistical model codes of PACE-4 and EMPIRE 3.2.2. And the evaporation residues ^{154}Dy (4n), ^{153}Dy (5n), and ^{153}Tb (p4n) are populated via xn/pxn emission channels and ^{150}Gd ($\alpha 4\text{n}$) via αxn emission channels in $^{12}\text{C} + ^{146}\text{Nd}$ system. The cross-sections of the above residues have been taken from PACE-4 and EMPIRE 3.2.2 and compared. Present work also suggests the production route for ^{149}Tb radioisotope via heavy-ion reactions. In the reaction $^{12}\text{C} + ^{142}\text{Nd}$, ^{149}Tb radioisotope has been produced, which is the only α -emitting radioisotope of Tb and is promising for targeted alpha therapy. Moreover, these reactions are important to understand the role of target deformation in fusion reactions above the Coulomb barrier as target ^{142}Nd is spherical and ^{146}Nd is deformed.

Keywords : heavy-ion reactions, radioisotopes, nuclear physics, target deformation

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