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Incomplete fusion reactions at low energies in $^{13}C+^{169}Tm$ system

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To understand the in-complete fusion (ICF) reaction dynamics at low energies (≈ 4-7 MeV/A), where complete fusion is expected to be the sole contributor, the excitation functions for several radio-nuclides populated in $^{13}C+^{169}Tm$ interactions have been measured and analyzed in the framework of statistical model. These residues were identified by their characteristic γ-rays and were further confirmed from their measured half lives. In these measurements the recoil-catcher technique followed by off-line γ-spectrometry has been used. The experiments for the presently studied system have been performed at the Inter University Accelerator Centre (IUAC), New Delhi, India using 15 UD Pelletron Accelerator facilities. In our investigations, some of the radio-nuclides populated are found to have contributions from their higher charge isobar pre-cursor decay, which have been separated out from the cumulative cross-section using the successive radioactive decays formulations [1]. The xn and pxn-channels are found to be satisfactorily reproduced by theoretical calculations. Further, in order to look into the production mechanism of α-emitting channels, the experimentally measured EFs have been compared with the PACE4 [2] calculations. The measured EFs for α-emitting channels are found to be significantly enhanced over the calculated values. This enhancement may be attributed to the contribution of ICF processes in these reaction channels. In order to achieve information on how does the fraction of ICF depend on various entrance channel parameters, the incomplete fusion fractions (F_{ICF}) have been deduced at these energies. The F_{ICF} is a measure of relative strength of ICF to the total fusion. A survey of the literature shows that, the mass-asymmetry systematic, as suggested by Morgenstern [3], for ICF is modified as a projectile dependent mass-asymmetry systematics given by Singh et. al [4]. According to Morgenstern et al. [3], the onset of ICF takes place as soon as $v_{rel} > 0.06$ (i.e., 6 % of c) and with increasing probability for more mass-asymmetric systems. In a recent communication [5], it has been observed that the ICF starts competing with complete fusion at noticeably lower v_{rel} -value and displays strong projectile dependence. However, Yadav et al. [6], summarized the probability of low energy ICF on the basis of α-Q value systematics, where, F_{ICF} decreases for projectiles having relatively large negative α-Q values. Therefore, in the present work the $^{13}C+^{169}Tm$ data has been compared with the existing ^{12}C, $^{16}O+^{169}Tm$ data [4,7], in order to proclaim the validity of the above systematics at low energies. Further details will be presented.

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