Fusion hindrance for asymmetric systems at deep sub-barrier energies

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The phenomenon of fusion hindrance, observed initially in symmetric systems involving medium-heavy nuclei at deep sub-barrier energies, has inspired current activities related to challenging low cross-section measurements [1, 2]. Theoretical models suggested to explain this behavior have different physical basis [3, 4]. The sudden model proposed by Mişicu [4] takes into account the nuclear incompressibility when the two nuclei overlap by including a repulsive core to density folded potential. In the model proposed by Ichikawa *et al.* [3] based on an adiabatic picture, a damping factor is imposed on the coupling strength as a function of the inter-nuclear distance to take into account a gradual change from the sudden to the adiabatic case. Reduction in tunneling probability as a result of Pauli exclusion principle has been studied recently using the density constrained frozen Hartree-Fock method [5]. However fusion hindrance is a generic property of heavy-ion collision below certain threshold energy in all the models. The data corresponding to asymmetric systems, presently scarce [6, 7], are important to understand the origin of the fusion hindrance and to establish the generic nature of this phenomenon.

We have recently investigated the evolution of the fusion hindrance as a function of increasing mass and charge of relatively light projectiles (both weakly bound and stable) on heavy targets [8]. A sensitive off-beam-γ-spectroscopy method to obtain the cross-section of residues from fusion, utilizing a coincidence between characteristic KX-rays and γ-rays from the daughter nuclei, has been developed for this purpose. It has been observed that the fusion hindrance gradually becomes larger in moving from lighter (^{6,7}Li) to heavier (^{12}C,^{16}O) projectiles. This result has been interpreted employing the adiabatic model [3] that reveals a weak effect of the damping of coupling to collective motion for lighter projectiles as compared to that obtained for heavier projectiles. We have performed a new measurement of fusion excitation function with ^{11}B beam on ^{197}Au target at Pelletron-Linac facility, Mumbai to probe further the behavior of fusion hindrance observed in Ref. [8] for asymmetric systems. In this talk we will present these recent results along with data over a wide range of target-projectile combination to highlight various aspects like charge product, coupling strength, weak binding etc that can influence occurrence of fusion hindrance.

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