Excitation function measurement in ^{20}Ne induced reactions on ^{27}Al

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Introduction

It has been observed that the possibility of reaction mechanisms other than compound nucleus formation via complete fusion cannot be ignored below 10 MeV/nucleon energy in heavy-ion induced reactions. Recently, many experimental evidences [1-5] are present to believe that projectile fusion with target leads to complete and incomplete fusion processes. However, at relatively higher excitation energies, deep inelastic collision (DIC), quasi elastic collision (QEC), transfer reaction (TR) and direct reaction (DR) processes are also likely to occur. In the CF reaction, whole projectile amalgam into the target nucleus, which involves all the nucleonic degrees of freedom to the compound nucleus, it decays by the particle emission like n, p and α-particle and/or γ-rays. On the other hand, in ICF reaction, projectile breaks-up into two parts, one part fuses with the target nucleus and remainder goes in the forward direction without any change in the velocity. This outgoing particle in the forward cone with large cross-section is called projectile like fragments (PLFs). Heavy-Ion Induced reaction on ^{27}Al has been reported by several groups, using different projectiles. Generally, aluminum is used as backing material for the preparation of non-self supporting targets, for light and heavy-ion induced reactions. The simple reason is that the background activities produced with aluminum is low. Hence, the yield of evaporation residues produced must be known precisely, especially in off-beam experiments, where as aluminum is generally used as backing material for reaction studies using various target materials. An attempt has been made to measure the excitation functions in ^{20}Ne induced reactions on ^{27}Al in the energy region 50-150 MeV with the interest of reaction dynamics as well as to extract some data of interest.

Experimental Procedure

Experiment for the excitation function measurement was carried out at Variable Energy Cyclotron Centre (VECC), Kolkata. For the measurement of excitation functions, stack of ^{59}Co foils backed by uniform thickness aluminum foils have been irradiated by ^{20}Ne beam at about 150 MeV energy in a vacuum chamber , specially designed` for this purpose. Weighted average beam current was measured in Faraday's cup kept behind the target-catcher assembly. Targets were made by depositing ^{59}Co onto aluminum foils of 2 mg/cm^2 thickness using vacuum evaporation technique. The energy loss suffered by 5.49 MeV α-particle obtained from ^{241}Am source, was used to determine the ^{59}Co and ^{27}Al foils thickness. A pre-calibrated 60 cc HPGe detector coupled to a PC based data acquisition system at VECC, Kolkata was calibrated both for energy and efficiency using standard ^{152}Eu γ- source and used for recording the γ-ray activities induced in each target-catcher assembly, irradiated between 50-150 MeV energy.

Results and Discussion

In the present data analysis the excitation functions of evaporation residues of many radio-isotopes of Sc, K, Ar, Cl, Mg and Na, produced in interaction of ^{20}Ne with ^{27}Al have been measured in the energy region of 50-150 MeV. It

has been found that the residues populated through complete fusion agree with the predictions of statistical model code PACE-2 [6], which gives only the CF contribution and does not take into account the other non-statistical reaction processes. It is interesting to note that the yield of the residues produced through non-non-statistical processes contributes very small and lies around few mb. Out of several measured excitation functions only three, associated with reactions ^{27}Al (Ne, 4p) ^{43}K, ^{27}Al (Ne, α) ^{43}Sc and ^{27}Al (Ne, 5 α 2pn) ^{24}Na , has been displayed in Figs.1-3. ^{43}K is produced through complete fusion; ^{43}Sc is expected to produced through incomplete fusion while ^{24}Na is expected to be produced through direct reaction process.

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