Study of Transfer angular distribution of ^{10,11}B + ^{232}Th systems

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Introduction:

In heavy ion reactions, there is a strong coupling of inelastic and transfer channels to fusion reactions, at near barrier energies. Thus a detailed understanding of the heavy ion reaction dynamics requires, a systematic and simultaneous study of the different reaction channels as a function of the bombarding energy [1, 2]. At energies near the Coulomb barrier, the role of projectile structure on reaction mechanism and the influence of the breakup process in the fusion cross sections have been reported earlier for weakly bound projectiles [3-5]. In the transfer reactions between two complex nuclei there are possibilities of various reaction paths such as sequential transfer, cluster transfer and multi-nucleon exchange processes [6]. Multi-nucleon transfer in heavy ion induced reactions provides information on the role of particles correlations and possible formation of cluster-states in nuclei.

In the present work, we have investigated transfer cross sections for ^{10,11}B + ^{232}Th systems from the measurement of the transfer angular distribution. Comparison between transfer and total reaction cross sections also have been derived. The total reaction cross sections have been obtained from the optical model analysis of the elastic scattering cross section data for both the systems at energies around the Coulomb barrier and transfer cross section obtained from transfer angular distributions at these energies.

Experimental details and results:

The experiment was performed using ^{10,11}B beams from BARC-TIFR Pelletron facility, Mumbai, India. A self supporting ^{232}Th target of thickness 1.5 mg/cm^2 was bombarded with the projectiles and the elastically scattered ^{10,11}B ion were detected by four silicon surface barrier detectors in ΔE-E telescopic arrangements. The telescopes used had a thickness (T_1) with ΔE = 25 μm and E = 300 μm (T_2) with ΔE = 40 μm and E = 300 μm (T_3) with ΔE = 25 μm and E = 300 μm and (T_4) with ΔE = 25 μm and E = 300 μm. Two monitor detectors with thickness around 300 μm were used for absolute normalization and beam monitoring. The transfer angular distribution measurements were carried out for different beam energies covering a wide range from 49 to 65 MeV for ^{10}B + ^{232}Th system and 52 to 65 MeV for ^{11}B + ^{232}Th system. A typical bi-parametric ΔE versus E_{res} spectrum for ^{11}B + ^{232}Th system at E_{lab} = 61 MeV and θ_{lab}= 90° is plotted in Fig. 1.

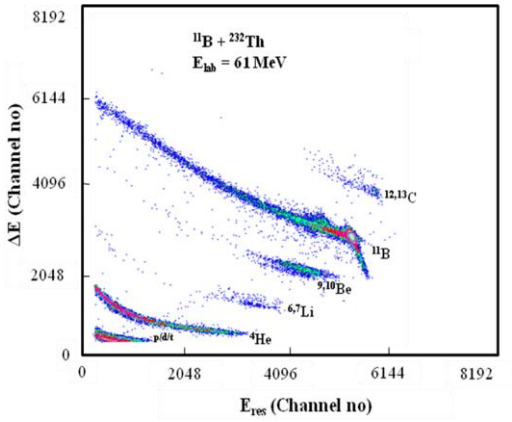

Fig.1. A typical bi-parametric ΔE versus E_{res} spectrum for ^{11}B + ^{232}Th system.

The transfer angular distribution has been measured in a wide angular range from 40^0 to 180^0. The transfer cross sections have been plotted as a function of scattering angle (θ_{lab}) for various bombarding energies as shown in Fig.2 for ^{10,11}B + ^{232}Th systems. We have

normalized the data at various angles with the yield of the monitor detectors. The transfer cross sections were obtained from the yield of the transfer products at various angles normalized with the Rutherford scattering events at forward angles. Fig. 2 shows the total transfer angular distribution data for ^{10,11}B + ^{232}Th systems, which includes ^{12,13}C, ^{9,10}Be and ^{6,7}Li for different bombarding energies.

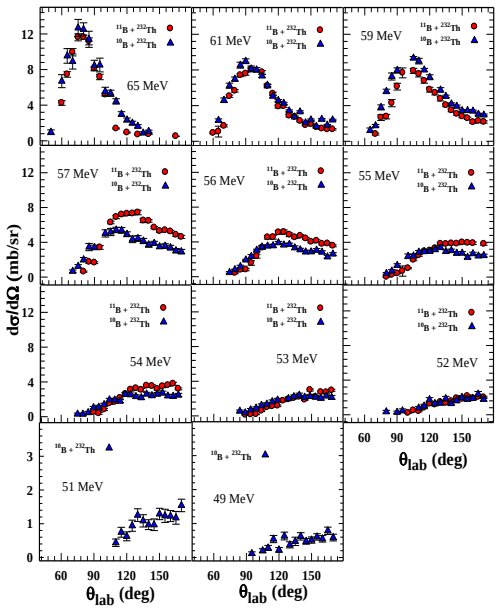

Fig.2. Transfer angular distributions for ^{12,13}C ^{9,10}Be and ^{6,7}Li at various bombarding energies for ^{10,11}B + ^{232}Th systems.

In the present work we have determined the total reaction cross sections for both the systems from the fitting of the elastic angular distribution data. For comparison we have plotted in Fig. 3, the transfer and total reaction cross sections. Although the transfer excitation function show similar behavior for both the systems, the total reaction cross section is enhanced for ^{10}B + ^{232}Th reaction at sub-barrier energies. This may be due to the contribution of the breakup fusion for ^{10}B + ^{232}Th reaction, because of the relatively smaller breakup threshold (4.46 MeV) of ^{10}B projectile, in comparison to ^{11}B (8.66 MeV).

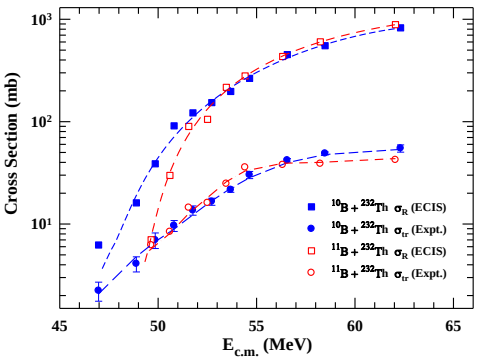

Fig. 3: Total reaction cross sections for ^{10}B + ^{232}Th system (solid square) and ^{11}B + ^{232}Th system (open square) derived from fit to the elastic scattering angular distribution using the ECIS code. Transfer cross section for ^{10}B + ^{232}Th (solid circles) and for ^{11}B + ^{232}Th (open circles). Dashed and dash-dotted lines are guide to eye.

More detailed analysis with different form of the potential is being carried out and the results will be presented in the symposium.

Acknowledgments:

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