Evaporation residue cross section measurement for the ^{28}Si + ^{188,192}Os reactions.

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Introduction

Measurements of hot fusion reactions in shell closed regions have considerable interest in super heavy elements (SHE) production. The study of SHE and their isotopes is an effort to understand the basic nature of nuclei and nuclear interactions and to explore the existence of nuclei in the proposed *island of stability* [1]. Fusion is the only established route to the SHE production till date.

Evaporation residue (ER) cross section measurements have shown considerable difference in the cross section and a very different trend with compound nuclear excitation energies in different isotopes of thorium as compound nuclei (CN) populated through different entrance channels [2, 3]. The CN populated in these studies were differing only by two neutrons. To explore the anomaly in the reported cross section and the difference in the trends of ER excitation function, we started systematic studies of ER cross sections of different isotopes of thorium populated through different entrance channel.

Here we report the ER cross section measurements for the ^{28}Si + ^{188,192}Os reactions at energies above the Coulomb barrier. Measurements of ^{35,37}Cl+^{181}Ta were previously reported [4].

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Experimental Details

The measurements were performed at the 15UD Pelletron + LINAC accelerator facilities of Inter University Accelerator Centre (IUAC), New Delhi. The reaction products were separated using the HYRA [5] facility operated in gas filled mode with helium gas at 0.15 Torr. Pulsed ^{28}Si beams with a pulse

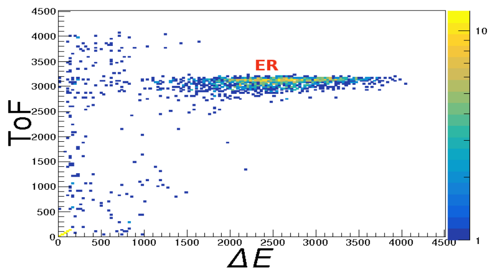

FIG. 1: The energy loss versus ToF spectrum for the reaction ^{28}Si + ^{192}Os at 157 MeV beam energy.

separation 2μs were used in the measurement. The measurements were carried out at beam energies 153, 157, 165, 174, 184, 194 and 204 MeV. Isotopically enriched Osmium targets (^{188}Os and ^{192}Os) used in this measurement were prepared by using electro deposition technique on thick copper backing at Radio Chemistry Division, BARC.

Target chamber consist of two monitor detectors, placed at 25^0 with respect to beam direction were used to detect the Rutherford scattered events. A position sensitive multi wire proportional counter (MWPC) of active area 6 inch × 2 inch was used to detect the ERs reaching the focal plane. MWPC was operated using isobutane as filled gas at a pressure of 2.1 mbar through out the experiment. A time of flight (ToF) spectrum was generated using the timing pulse from the MWPC anode signal as the start and the suitably delayed radio frequency (RF) signal as stop. The energy loss signal (ΔE) versus ToF spectrum enabled an unambiguous identification of the ERs from other scattered particles reaching the focal plane. Fig. 1 shows two dimensional plot of the ΔE versus TOF spectrum for the ^{28}Si + ^{192}Os reaction at 157 MeV beam energy.

Data Analysis

ER cross section (σ_{ER}) is calculated using the equation:

$$\sigma_{ER} = \frac{Y_{ER}}{Y_{mon}} \left(\frac{d\sigma}{d\Omega}\right)_R \Omega_M \frac{1}{\varepsilon_{HYRA}} \qquad (1)$$

where Y_{ER} is the ER yield at the focal plane detector, Y_{mon} is the yield in the monitor detector, ε_{HYRA} is the HYRA transmission efficiency and Ω_M is the solid angle subtended by the monitor detector.

In the present run, we used the ^{28}Si+^{180}Hf reaction [6] for calculating the ε_{HYRA}. For this purpose we measured the ER cross section for the ^{28}Si+^{180}Hf reaction at 194, 184, 174, 165 and 157 MeV beam energies.

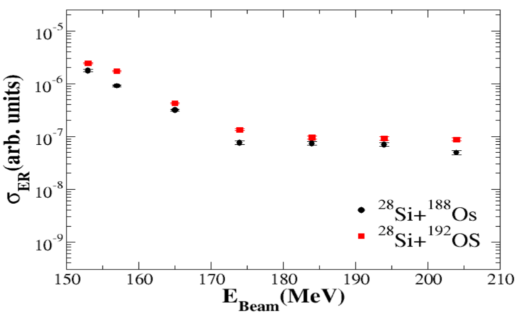

FIG. 2: Preliminary result for experimental ER cross sections in arbitrary units for the reactions ^{28}Si + ^{188,192}Os.

Results and Conclusion

In Fig. 2 we have shown the preliminary results of the trend of ER cross section for ^{28}Si + ^{188,192}Os reactions in arbitrary units. Cross sections for both the systems show decreasing trend with excitation energies which could be due to the increased fission competition at higher excitation energies. Also the heavier isotope of the CN shows larger ER cross sections which could be the reflection of decrease in neutron binding energy and the fissility of the CN with increasing neutron number with compound system, both favoring the neutron evaporation over fission decay in heavy isotopes. Similar observations have been observed in Ref [7, 8]. The detailed analysis of the data is in progress.

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