Evaporation residue cross-section measurements for ^{48}Ti-induced reactions

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Background: A significant research effort is currently aimed at understanding the synthesis of heavy elements. For this purpose, heavy ion induced fusion reactions are used and various experimental observations have indicated the influence of shell and deformation effects in the compound nucleus (CN) formation. There is a need to understand these two effects.

Purpose: To investigate the effect of proton shell closure and deformation through the comparison of evaporation residue (ER) cross sections for the systems involving heavy compound nuclei around the $Z_{CN} = 82$ region.

Methods: A systematic study of ER cross-section measurements was carried out for the ^{48}Ti + ^{142,150}Nd, ^{144}Sm systems in the energy range of 140–205 MeV. The measurement has been performed using the gas-filled mode of the hybrid recoil mass analyzer present at the Inter University Accelerator Centre (IUAC), New Delhi. Theoretical calculations based on a statistical model were carried out incorporating an adjustable barrier scaling factor to fit the experimental ER cross section. Coupled-channel calculations were also performed using the CCFULL code to obtain the spin distribution of the CN, which was used as an input in the calculations.

Results: Experimental ER cross sections for ^{48}Ti + ^{142,150}Nd were found to be considerably smaller than the statistical model predictions whereas experimental and statistical model predictions for ^{48}Ti + ^{144}Sm were of comparable magnitudes.

Conclusion: Though comparison of experimental ER cross sections with statistical model predictions indicate considerable non-compound-nuclear processes for ^{48}Ti + ^{142,150}Nd reactions, no such evidence is found for the ^{48}Ti + ^{144}Sm system. Further investigations are required to understand the difference in fusion probabilities of ^{48}Ti + ^{142}Nd and ^{48}Ti + ^{144}Sm systems.

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I. INTRODUCTION

In recent years, a great deal of experimental as well as theoretical work has been carried out in order to understand the fusion-fission reactions leading to heavy element formation. The fusion of nuclei is governed by a delicate balance between the attractive nuclear and repulsive Coulomb interactions,

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