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Study of Reaction Mechanisms in α + ^{69}Ga reaction at ≈10 – 50 MeV

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ABSTRACT

The excitation functions of ^{69}Ga(α, n)^{72}As, ^{69}Ga(α, 2n)^{71}As, ^{69}Ga(α, 3n)^{70}As, ^{69}Ga(α, x)^{69}Ge, ^{69}Ga(α, x)^{68}Ga and ^{69}Ga(α, x)^{67}Ga reactions produced in the interaction of α-projectile with ^{69}Ga-target were studied at ≈ 10-50 MeV. The produced nuclei were different isotopes of As, Ge, and Ga, some of which have important medical applications. The theoretical model predictions were based on the statistical code COMPLETE, and the predicted results were compared and discussed with existing experimental data. Good agreement between the theoretical predictions and experimental results were obtained. Pearson's relational statistics showed moderate to strong positive correlations between the theoretically predicted and experimentally measured reaction cross-sections. Furthermore, the present investigation revealed significant pre-compound contributions in the studied energy range. Therefore, it is important to consider the admixture of pre-equilibrium and equilibrium modes of reactions when predicting the reaction cross-sections.

INTRODUCTION

Advances in accelerator technology and cyclotrons have enabled the use of light- and heavy-charged nuclei as projectiles in nuclear reactions. This development has improved our understanding of the reaction mechanism and nuclear structure at various energies near and above the Coulomb barriers (Cavinato *et al*., 1995; Amorini *et al*., 1998; Gadioli *et al*., 1998). For example, at moderate excitation energies, reactions induced by nucleons and light-charged projectiles are found to proceed through the equilibrium (EQ) and pre-equilibrium (PE) mode reactions (Baure *et al*., 1995;Agrawal *et al*., 2001; Patronis *et al*., 2007; Johari and Saxena, 2015). To understand these reaction mechanisms, reaction cross-section data evaluation is essential. Accordingly, comparative studies based on experimental data and theoretical predictions are demanding. In this regard, nuclear reaction model-based computer codes can swiftly help to predict unknown reaction cross-sections and thus improve computer code predictions.

Studies of light-charged induced nuclear reactions help better understand the reaction mechanisms and test the validity of various available and newly evolving computer codes. Furthermore, in light-charged induced nuclear reactions, the processes of PE and EQ particle(s) emissions are vital in comprehending and characterizing the reaction mechanisms, attributable to the strong competition between PE and EQ mode of reactions at moderate excitation energies.

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