Isotopic Effect in ER Cross Sections for Heavy Ion Reactions.

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Introduction

The systematic study of the dependence of ER (Evaporation Residue) cross section on various parameters is of prime importance in the area of nuclear physics research. In the heavy ion induced nuclear reactions if there is a central collision of the projectile with the target, with sufficient energy available there may be 1) a complete fusion of the two reacting partners and completely equilibrated compound system may be formed. This hot rapidly rotating mononuclear system may either end as ERs by emitting neutrons and/or protons or gamma rays or if the excitation energy of the compound nucleus is high enough it will undergo the binary fission process so called fusion-fission 2) the di-nuclear system before the complete fusion may break up as the fission like fragments without forming a true compound nucleus. This non compound nuclear process is called quasi-fission and it hinders the formation of ERs. Recent studies on heavy ion induced reactions in the mass region A=200 shows that there is a marked decrease in the ER formation cross section due to this non compound nuclear processes. Since ERs are the true signatures of compound nuclear formation their study helps us to reveal the complete nuclear reaction mechanism satisfactorily.

The evaporation residue formation probability depend on several factors such as entrance channel charge asymmetry Z_pZ_t, mass asymmetry, deformation of the projectile and the target, deformation of the compound system formed, and the sell closure of the reacting partners etc.

Present study

The measured ER cross sections taken from the literature for the two set of reactions, each set form the same compound nucleus with different neutron number are plotted as a function of excitation energy. The ER excitation functions of the following systems are compared.

16O+184W—>200Pb[1,2,3]
16O+186W—>202Pb[4,5,6]
16O+186Os—>202Po[7]
16O+188Os—>204Po[8,9]
18O+192Os—>210Po[10]

The parameters describing each system is included in the table given below:

CN	system	ZpZt	ɑ	N/Z
200Pb	16O+184W	592	0.840	1.43
202Pb	16O+186W	592	0.842	1.46
202Po	16O+186Os	608	0.842	1.40
204Po	16O+188Os	608	0.843	1.42
210Po	18O+192Os	608	0.829	1.5

The variation in the measured ER cross sections plotted as a function of excitation energy is shown in the following figures.

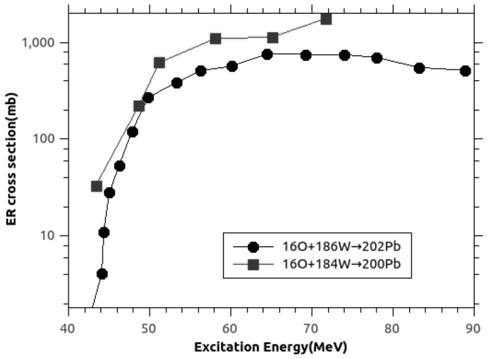

Fig.1 The measured ER cross section of 16O+184W and 16O+186W.

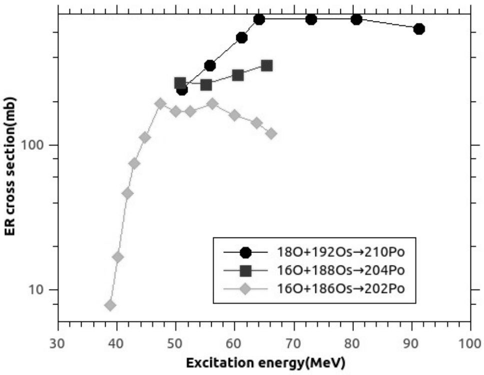

Fig 2. The measured ER cross section of 16O+186Os, 16O+188Os, 16O+192Os.

Analysis

The ER excitation function of the reactions shows that there is a marked difference between the measured ER cross sections for different systems depending upon the various parameters describing the system. In fig 1. the ER cross sections is more for 16O+184W than 16O+186W. Here both reactions have the similar entrance channel properties and differ in the neutron number of the targets (184W and 186W) and the compound nuclei (200Pb and 202Pb) formed. As the neutron number increases there is a strong probability for ER formation but here the compound nucleus formed is Pb, which has Z=82, it is a magic number. The N/Z ratio is more for 202Pb than the other. If the compound nucleus formed has a magicity as the N/Z ratio increases the evaporation residue decreases.

In fig 2. the ER cross sections of the Po compound nucleus through different channel is plotted. From the fig which is very clear that as the N/Z ratio of the compound nucleus or thr target increases the ER cross section also increases due to the fast emission of the excess neutrons from the compound nucleus and it lead to the formation of heavy evaporation residues.

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