Mass Asymmetric Fission Barriers for Neutron-Rich and Neutron-poor Compound Nuclei ^{76,70}Se

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Earlier work [1,2] by this group studied the mass aymmetric, conditional-fission barriers for the compound nuclei ^{75}Br and ^{90,94,98}Mo. In this work, complex fragment emission ($4 < Z < 21$) has been studied at over six bombarding energies for ^{76}Se and ^{70}Se produced in the reactions ^{64,58}Ni + ^{12}C, representing neutron-rich (n/p=1.24) and neutron-poor (n/p=1.06) nuclei of atomic number Z=34. Excitation functions have been constructed for each Z value. Mass asymmetric barriers have been extracted by fitting the measured excitation functions with a transition state formalism.

The experiment was performed at the 88-Inch Cyclotron of LBNL. To create the excited compound nuclei ^{76,70}Se, a carbon target (1.0 mg/cm^2) was bombarded with beams of ^{64,58}Ni at several energies ranging from 5.8 MeV/u to 14.1 MeV/u. The use of reverse kinematics provides a clear signature for the production of complex fragments by a binary-decay mechanism [3]. Eight $E - \Delta E$ telescopes, each consisting of a gas ΔE followed by a position-sensitive silicon detector, provided the energy, atomic number, and spatial location of each detected fragment. Velocity spectra were obtained for each fragment Z-species. The isotropic emission of complex fragments in the reaction plane can be seen from the decay of the two nuclei ^{76,70}Se.

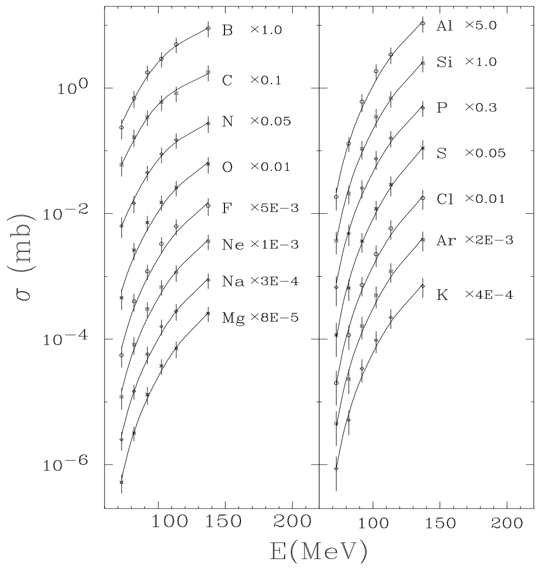

FIG. 1. Dependence of the total integrated cross section on the center-of-mass energy for emission of complex fragments from the reaction ^{64}Ni + ^{12}C. The curves are fits. The number to the right indicates the factor by which each curve and the set of experimental points are multiplied.

The $d\sigma/d\theta$ distributions in the frame of the source system were determined for all fragment Z-values. Angle-intergrated cross sections for the isotropic component were determined from the averaged $d\sigma/d\theta$ of the flat regions in the angular distributions. The charge distributions of complex fragments associated with fusion-like reactions at all the bombarding energies have been determined. The corresponding excitation functions for ^{64}Ni + ^{12}C are shown in fig. 1. Each excitation function was fitted with a conditional barrier B_Z and the ratio of the level-density parameter at the saddle point to that of the ground state (a_Z/a_n). Fig. 2 illustrates the macroscopic conditional barriers and the ratios of level density parameters a_Z/a_n for the compound nuclei ^{76,70}Se. Comparison with macroscopic nuclear models and further analysis are underway.

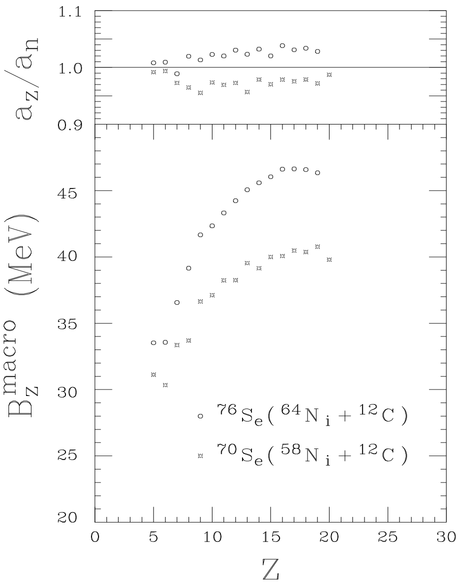

FIG. 2. Preliminary values of the mass-asymmetric fission barriers (B_Z^{macro}) , which corresponds to the mass difference between the saddle point and the spheric liquid drop, and the ratio of the level density parameters (a_Z/a_n) for compound nuclei ^{76,70}Se, extracted from the fitting of the excitation functions.

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