Calculation of Fission Yield by Macroscopic-Microscopic Method Based on Selective Channel Scission Model

Masayuki OHTA and Shoji NAKAMURA
Japan Atomic Energy Agency
Tokai-mura, Naka-gun, Ibaraki, 319-1195, Japan
e-mail: ohta.masayuki@jaea.go.jp

The selective channel scission (SCS) model has been proposed and developed to calculate fission yields for any nuclei [1-3]. The SCS model deals with the fission process for each channel. The fission yield is obtained from the penetrability of the "channel-dependent" fission barrier. In previous analysis [3], mass-distributions of fission yields were calculated on simple assumptions about the channel-dependent fission barriers. This calculation method is applicable to wide range of fissionable nuclei without adjustable parameters. However, there were discrepancies between the calculated results and experimental data of fission yields in mass regions of A = 140–150 (and A = 85–95).

A macroscopic-microscopic method is commonly used for the calculation of fission potential. The total potential energy of a deformed nucleus is defined as the summation of the liquid-drop energy as a macroscopic term and the shell correction energy as a microscopic term in this method. The liquid-drop energy is derived from the surface energy and the Coulomb energy of the deformed nucleus. In this work, the channel-dependent fission potentials were calculated by a macroscopic-microscopic method based on the idea of SCS. The surface energy in the macroscopic term was obtained from an equation whose form was proportional to the surface area of the deformed nucleus. The Coulomb energy also in the macroscopic term was obtained by the Monte-Carlo integral of the Coulomb energy between differential volumes which were taken at random all over the region of the deformed nucleus. The shell energy in the microscopic term was calculated approximately as follows. The two fission fragments were assigned to the shape of the deformed nucleus for a channel. The whole shell energy was calculated from the sum of the shell energies of the two deformed fission fragments assigned to the deformed nucleus. A calculation code [4] was used for the calculation of shell energy for each fission fragment.

The mass-distribution of fission yield will be reported for the neutron-induced fission of U-235. The present result will be compared with the previous result [3] from the aspect of fission modes.

References

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