Fission Fragment Mass Distributions of Np, Pu and Am Isotopes Utilizing Multi-Nucleon Transfer Reactions

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Fission fragment mass distributions (FFMDs) of ^{237,238,239}Np, ^{238,239,240}Pu and ^{241,242,243}Am nuclei, and their dependence on excitation energy up to 70 MeV, have been measured at the JAEA-Tokai Tandem Accelerator Facility, employing multi-nucleon transfer (MNT) reactions using an ^{18}O beam and ^{237}Np target.

Keywords: Nuclear fission, multi-nucleon transfer reaction, fission fragment mass distribution, neptunium, plutonium, americium

1. Introduction

FFMD are interpreted in terms of symmetric and asymmetric modes which are linked to the shell structure of the CN and FFs. The current work looks at the excitation energy dependence of the FFMD of various actinide nuclei, with the aim to provide more information regarding the distribution of waste products following the transmutation of actinide waste in accelerator driven systems (ADS).

2. Method

The JAEA-Tokai Tandem accelerator facility was utilized for the current work, supplying an ^{18}O beam with an energy of 162 MeV. This beam impinged on a target of ^{237}Np, leading to many excited compound nuclei (CN; ^{237,238,239}Np, ^{238,239,240}Pu, ^{241,242,243}Am), via MNT reactions, which then undergo fission. CN and their excitation energies were identified by detecting ejectiles with a silicon ΔE-E telescope [1,2]. Fission fragments were detected in coincidence with two multi-wire proportional counters (MWPCs), and FFs masses were determined by a kinematic consideration.

3. Results

Preliminary results show the transition from asymmetric fission to asymmetric fission as CN excitation energy increases. Figure 1 shows the case for ^{241}Am. All the measured nuclei investigated in this experiment showed similar behavior. Aside from Np, Pu and Am isotopes, FFMD will also be shown for various Cm, Bk and Cf isotopes.

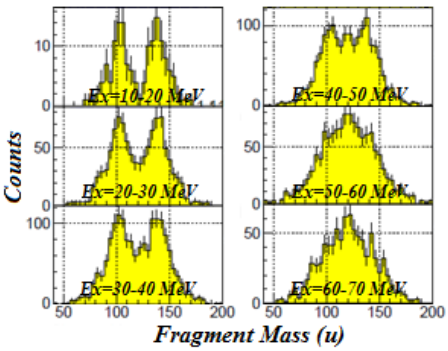

Figure 1 - Preliminary FFMD as function of excitation energy for the example of ^{241}Am for various ranges of excitation energy, Ex.

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References

[1] Katsuhisa Nishio *et al*. Physics Procedia 64 (2015) 140.

[2] Romain Leguillon *et al*. Phys. Lett. B (submitted).