Neutron-induced Fission Cross Sections of Short-lived Actinides via the Surrogate Reaction Method

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The neutron induced compound nuclear cross sections are required for nuclear energy, national security and nuclear astrophysics applications [1]. The renewed interest in nuclear energy has led to design of new reactor systems based on fast neutron induced fission. The transuranic nuclide produced in the nuclear fuel cycles by successive neutron capture, play prominent role in modeling processes that are relevant to generate energy. The fast-neutron induced reactions have also been proposed for the incineration of actinide materials, notably minor actinide isotopes which are produced in Th-U or U-Pu fuel cycles. Unfortunately, for a large number of reactions the relevant data cannot be directly measured in the laboratory, since the relevant nuclei are often too difficult to produce with currently available experimental techniques or too short-lived to serve as target in present day setups. The Surrogate reaction methods provide access to such nuclear data indirectly.

In recent years, the surrogate reaction methods in various forms have been employed to get indirect estimate of the neutron induced fission reaction cross sections of many compound nuclear systems in actinide region, which are not accessible for direct experimental measurements. Recently, we have developed a new experimental technique known as hybrid surrogate ratio method[2] and successfully employed to determine ^{233}Pa(n,f), ^{234}Pa(n,f), ^{239}Np(n,f), and ^{240}Np(n,f) compound nuclear cross sections in the equivalent neutron energy range 10.0 to 16.0 MeV by measuring the ratio of fission decay probabilities in [^{232}Th(^{6}Li,α)^{234}Pa/^{232}Th(^{6}Li,d)^{236}U], [^{232}Th(^{7}Li,α)^{235}Pa/^{232}Th(^{7}Li,t)^{236}U], [^{238}U(^{6}Li,α)^{240}Np /^{238}U(^{6}Li,d)^{242}Pu], and [^{238}U(^{7}Li,α)^{241}Np / ^{238}U(^{7}Li,t)^{242}Pu] transfer reactions respectively[2-4]. We have also determined ^{241}Pu(n,f) cross section in the equivalent neutron energy range 11.0 MeV to 18.0 MeV using ^{238}U(^{6}Li,d)^{242}Pu and ^{232}Th(^{6}Li,d)^{236}U transfer reactions employing surrogate ratio method[5].

In this talk, we start with a brief discussion of surrogate reaction methods and present some of the recent results on neutron induced fission cross section measurements. We also discuss the validation of the EMPIRE-3.1[6] predictions on neutron induced cross sections corresponding to fission barriers used from Barrier Formula (BF) [4] and RIPL-1 libraries [7].

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