Measurement of fission cross sections

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Fission play an essential role in nuclear energy through regeneration of neutrons. For the reason, fission cross section has been a critical issue in the development of nuclear energy and still be of a key parameter for development of new reactor system like ADS (Accelerator driven system), low moderation reactors and high burn up reactors etc. For the reasons, cross section requirement is extending to high energy regions and proton-induced reactions, minor actinide elements.

In reply to the requirement, world–wide effort is given for the improvement of fission cross section data through development of new facility and experimental techniques. It should be noted, in the case of fission cross sections, experimental data are of special importance because the data accuracy required is far beyond that which can be reached by nuclear reaction theories.

In the fission cross section studies, there are two big problems. One is the fact that fissionable nuclides in particular higher actinides elements are highly α-emitting ones, and the other one is that sample is not always available.

The first one introduces serious backgrounds in fission cross section measurement through fission fragment detection. For precise fission cross section measurement, therefore, high neutron flux and suppression of α-particle events are essential. Development of high flux neutron fields has been essential to provide improvement of fission cross section as well as fission fragment detectors with fast responses. Among them, development of Lead slowing down neutron spectrometers enabled discovery of sub-threshold fission of ^{238}U and great progress in minor actinide cross sections via much higher neutron flux. Recent remarkable activity in n-TOF projects are owing to very high neutron flux provided by spallation neutron source with 24 GeV protons. A new lead slowing down spectrometer is constructed at LANL and driven by an intense proton beam from LANSCE/WNR to enable fission cross sections of minor elements as few as ~10 ng.

The second problem introduces problems in the case of short lived elements which is important in the assessment of nuclear transmutation like ^{233}Pa, and ^{238}Np. Recently a “surrogate” techniques is actively employed to obtain cross sections of “exotic” nuclei using (d,pf) and so on using stable nuclei in place of direct neutron induced-reaction on unstable elements.

In the symposium, recent progress and activity in fission cross section studies are reviewed and the activity in special project research for neutron cross sections for advanced reactors will be introduced.