Effect of N/Z and dissipation in the fission of ^{212,214,216}Ra nuclei via neutron multiplicity measurements

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Pre-scission neutron multiplicity (ν_{pre}) is one of the best probes to understand the evolution of the compound nucleus formed in heavy ion fusion. Measured ν_{pre} is observed to be larger than the standard statistical model (SSM) [1] predictions in many cases [2, 3] and were attributed to the dynamical delay or dissipation involved in fission. A few attempts have been made to understand the effect of neutron shell closure, N/Z and dissipation in fission dynamics. The deduced dissipation strength is shown to have a strong temperature dependence in some of these works [4, 5]. Contradicting results are also reported. A correlation between the shell closure and dissipation strength is also worked out in a few cases [4].

We measured the pre-scission neutron multiplicity for the ^{30}Si+^{182,184,186}W reactions populating ^{212,214,216}Ra compound nuclei. Among the CN populated, ^{214}Ra has neutron shell closure (N=126) and others are two neutrons away on either sides. It is observed that the measured ν_{pre} values increase with increasing N/Z of the compound nuclei at all excitation energies. However the measured ν_{pre} does not show any noticeable effect of shell closure at N=126. Statistical model analysis [6] of the ν_{pre} excitation function has been performed including the collective enhancement of level density (CELD), shell correction at fission barrier and level density, K-orientation effect in fission width and dissipation. The strength of pre-saddle dissipation was fixed by reproducing the evaporation residue cross section for the ^{30}Si+^{186}W reaction and varied the strength of post-saddle dissipation according to the measured ν_{pre} values. The measured ν_{pre} values are observed to be larger than the Bohr-Wheeler predictions indicating the effect of dissipation. Strength of the deduced dissipation coefficient does not show any effect of neutron shell closure in the measured excitation energies and does not vary with the N/Z of the fissioning nuclei. Most importantly, the dissipation strength does not show any temperature dependence unlike reported earlier [5]. Emission of pre-saddle neutrons is observed to be energy independent. A substantial contribution to ν_{pre} comes from the post-saddle phase of shape evolution. CELD and K-orientation effects are also observed to be significant in these nuclei.

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