Contribution ID: **96** Type: **Poster Presentation**

DPA Calculational Methodologies Used in Fission and Fusion Reactor Materials Applications

Tuesday, 20 May 2014 17:30 (1h 30m)

Well-developed methodologies have been extensively applied to predicting radiation damage in materials for the neutron irradiation environments typically encountered in reactor test irradiations. Decades of reactor experience have resulted in standardized methods. An example is the ASTM standard dpa cross section for iron based reactor materials based on the traditional NRT-dpa model. Folding of calculated neutron energy spectra with neutron damage cross sections derived from ENDF/B evaluations as a function of accumulated neutron fluence is a typical application in reactors. Various dpa methodologies have been proposed in an attempt to correlate reactor irradiations in various neutron spectra and with the much higher damage rates in charged particle irradiations. Methods applied for neutron irradiation of reactor materials will be compared to methods used for charged particle irradiations. The basics of these techniques will be described, along with some of the limitations of the methodologies for predicting material behavior. The use of MCNPX in calculating the radiation environments, dpa, and gas production in both nuclear reactor and charged particle irradiations will be described.

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Session Classification: HPTW Poster Session & Reception

Track Classification: Radiation Damage and Material Limits