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Other applications of IFMIF/DONES: Material irradiations at high neutron fluences and high energies

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Abstract

IFMIF, the International Fusion Material Irradiation Facility, was conceived as intense neutron source for the high fluence irradiation and qualification of materials considered for the use in future fusion power reactors. A key issue of IFMIF is thus to provide a neutron flux density around 10^{14} -10^{15} $cm^{-2}s^{-1}$ with a "first-wall-like" fast neutron spectrum and a continuous irradiation scheme at the desired elevated temperature levels. The accelerator based IFMIF neutron source can provide such conditions in a small irradiation volume with two deuteron beams (125 mA, 40 MeV) impinging on a liquid Lithium target. The material specimens are placed in a carefully designed and optimised irradiation assembly called High Flux Test Module (HFTM). The HFTM is backed/surrounded with further modules for the irradiation at lower flux levels. Together with the Lithium target these Test Modules are arranged in the Test Cell room which has a typical dimension of 4x4x3 m^3.

DONES, the Demo Oriented NEutron Source is currently under development within the Early Neutron Source (ENS) project of EUROfusion's Power Plant Physics and Technology (PPPT) programme. DONES is projected as intermediate irradiation test facility with a reduced performance goal aiming, however, at the provision of irradiation data required for the construction of DEMO within the time schedule assumed in the European fusion roadmap. DONES utilizes just one full IFMIF accelerator with a deuteron beam of 125 mA and 40 MeV producing half the neutron intensity of IFMIF. This approach allows upgrading DONES at a later stage to the full IFMIF performance with a second accelerator. Lithium target, Test Cell and HFTM of DONES and IFMIF are identical while other irradiation modules are not considered in DONES. The absence of other irradiation modules in the full size Test Cell of DONES allows utilizing the available radiation field for other irradiation purposes without strong interference or impact on DONES' primary mission.

In this presentation we provide an overview of such irradiation possibilities taking benefit of IFMIF/DONES' unique feature to produce continuously high neutron fluences at high neutron energies. Even for threshold reactions such conditions result in comparatively high transmutation rates which cannot be achieved in other irradiation facilities. The radiation fields are characterised in terms of flux distributions, fluences, spectra, and specific responses for non-fusion ("other") applications.