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TMS 2023

152nd Annual Meeting & Exhibition

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SAN DIEGO CONVENTION CENTER &
HILTON SAN DIEGO BAYFRONT
SAN DIEGO, CALIFORNIA, USA
#TMSANNUALMEETING

SUBMIT AN ABSTRACT BY JULY 1 FOR THE FOLLOWING TMS2023 SYMPOSIUM:

NUCLEAR MATERIALS

Transmutation Effects in Fusion Reactor Materials: Critical Challenges & Path Forward

Realization of fusion energy on Earth requires high-performance radiation-tolerant structural and functional materials that can withstand extreme operating conditions envisaged for the fusion first-wall/blanket and plasma-facing components. A major technical gap in the fundamental understanding of fusion-specific radiation damage is due to the high transmutation product generation rates by the fusion neutron spectra, as compared to fission neutrons. Therefore, severe performance degradation due to the synergies between neutron damage and transmutation products is expected for numerous candidate materials for a variety of applications in fusion concepts like the Demonstration Power Plant (DEMO) in EU/Japan or the Fusion Neutron Science Facility (FNSF) in the United States. Specific examples include reduced activation ferritic-martensitic (RAFM) steels or oxide dispersion strengthened (ODS) steels for the first-wall/blanket, tungsten alloys for divertor, copper alloys for high-heat flux components or radio-frequency launchers, silicon carbide (SiC)/SiC ceramic composites for coolant channels, and lithium-based oxides for solid breeders, to name a few. Until a fusion prototypic neutron source becomes available, grassroots research that can simulate the effect of transmutation products for future validation with 14 MeV neutrons is required using fission neutrons, spallation neutron sources, and accelerator-based energetic ions.

This symposium is targeting state-of-the-art investigations and technologies on understanding transmutation effects in fusion reactor materials. Investigations involving neutron irradiations, innovative techniques of experimentally simulating transmutation effects, and novel facilities to study transmutation-related damage situations, especially under the application of thermo-mechanical stresses, are strongly encouraged. This symposium also calls for modelling studies related to transmutation damage and on inventory build-up calculations for future fusion devices.

Topics of interest include, but are not limited to, the following key aspects:

- Helium and hydrogen effect in first-wall/blanket structural materials (ferritic-martensitic steels/iron chromium alloys, ODS steels, tungsten alloys, copper alloys, SiC/SiC): Thermo-mechanical properties degradation
- Transmutation and irradiation damage in tungsten, with specific attention to the effect of rhenium and osmium generation
- Synergistic transmutation and radiation damage in structural and functional non-metals
- Performance degradation of solid breeders by loss of lithium due to tritium and helium generation, and including neutron multipliers
- Effect of applied stress on transmutation product migration and clustering
- Modelling of point-defects and transmutation product interactions
- Interaction of transmutation products with microstructural sinks and extended defects
- Evaluation of irradiation spectrum transmutation effects on material behavior in fission, fusion, and spallation neutron environments: novel experiments using existing facilities, inventory build-up calculations

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