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# P3.104 Tritium permeability in polycrystalline tungsten

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Nuclear fusion promises to deliver an abundant, carbon-free and clean energy source for the future. Before the realization of nuclear fusion energy, the fusion community must solve immense technological safety challenges related to tritium permeation in materials under an extreme fusion nuclear environment. Tritium behavior in materials determines two crucial safety evaluation source terms: in-vessel inventory source term and ex-vessel release term, which are used in reactor safety assessments for licensing fusion facilities. Extensive work on hydrogen and deuterium permeation behavior in fusion materials has been conducted, but only a small database is available for tritium, the radioactive fuel for future reactors, due to the cost and difficulty associated with handling tritium [1]. A gas-driven tritium permeation system that is capable of independently controlling hydrogen and tritium partial pressures was developed at Idaho National Laboratory to enhance the tritium permeability database in fusion reactor materials [2].
In this paper, we discuss tritium permeation behavior in polycrystalline tungsten (99.95% purity, 20.0 mm OD disc, 25.4-127 μm thick) in a hydrogen-tritium system (T2 partial pressure range from 10-6 to 10 Pa) and specimen temperatures up to 600 ℃ to uncover the basic scientific understanding of tritium permeation behavior in tungsten, the leading candidate plasma-facing material for DEMO.

[1] R.A. Causey, R.A. Karnesky, and C. San Marchi, “4.16 Tritium Barriers and Tritium Diffusion in Fusion Reactors”, Comprehensive Nuclear Materials (2012) Chapter 4.16.
[2] M. Shimada and R.J. Pawelko, “Tritium Permeability Measurement in Hydrogen-Tritium System, Fusion Engineering and Design, 129 (2018) 134.

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**Presenter:** SHIMADA, Masashi (Fusion Safety Program Idaho National Laboratory)

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