Contribution ID: **84** Type: **not specified**

# Tritium permeation and inventory in DEMO Eurofer97 exposed to water

*Wednesday, February 22, 2023 2:30 PM (20 minutes)*

Tritium containment and control are essential prerequisites for fusion to comply with the promise of a safe energy with low impact on the environment. In particular, tritium inventory and permeation in the walls of fusion reactors need to be assessed. This evaluation requires a better understanding of tritium permeation and trapping in plasma-facing components. In particular, little data is available regarding the permeation and inventory of tritium in the reduced-activation steel Eurofer97. The most commonly cited papers ([1,2]) refer mostly to transport parameters (such as diffusivity) and do not focus on trapping, although it is known to impact permeation in the operational temperature range of this material.

As tritium experiments are complex, expensive and require specific laboratories, most of the investigations are performed using hydrogen or deuterium. Our method follows this trend by starting with hydrogen or deuterium experiments for the most part, continued by specific tritium experiments.

Hydrogen gas-driven permeation and deuterium thermal desorption spectrometry experiments are coupled with the reaction-diffusion code MHIMS to obtain a cohesive model that covers transport and trapping. In particular, this model requires three trapping sites, one of which has a high detrapping energy of 1.65 eV. This model can be used in MHIMS simulations to show the influence of the reversibility of trapping sites (i.e., their capacity to release their hydrogen content at a given temperature) on the dynamics of permeation. In particular for Eurofer97, the presence of irreversible trapping sites has been shown to increase the inventory and delay the permeation timelag, and to be in contradiction with the use of effective diffusivity although this model is widespread [3].

Using the three-traps model MHIMS simulations as a basis, the Wapiti experiment (WAter-interface Permeation In Tritium-exposed materIals) was designed. This experimental device consists in several permeation cells where thin metallic samples are exposed to gaseous tritium at room temperature. It allows us to extend our operational range to low temperatures and to the presence of water downstream, in order to challenge our model and to complete it with the description of new phenomena such as the interaction of water with Eurofer97. The preliminary results indicate that in the presence of water, the permeation flux into air is reduced, and that the amount of tritium permeating into water is larger than the one permeating in air.

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**Session Classification:** Gas-driven permeation