Isotope effects on mixed plasma-driven co-permeation found through RAFM steels

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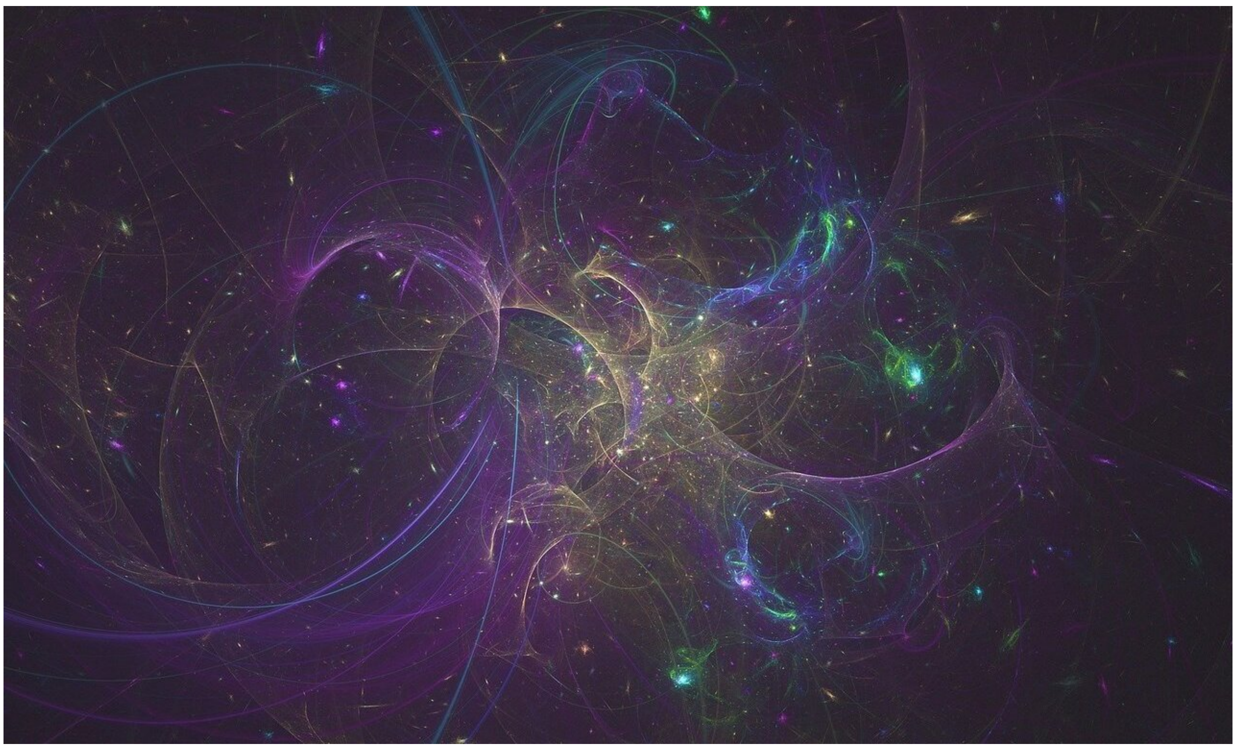

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Researchers from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences, in collaboration with the International Thermonuclear Experimental Reactor (ITER) organization and the Southwest Institute of Physics, carried out a study on the isotope effects of mixed plasma-driven co-permeation based on the Chinese Helium

Cooled Ceramic Breeder test blanket module (TBM) first wall, which is made of CLF-1 Reduced Activation Martensitic/Ferritic (RAFM) steel.

The purpose of the TBM program is to test the validations of tritium (T) breeding rate predictions, recovery process efficiency and inventories in blanket materials. However, the plasma-driven permeated T may be mixed into the T produced from the intended Li (n, T) He reactions between the fusion neutrons and the breeding material, thus significantly affecting the assessment of TBM's breeding rate.

Meanwhile, because the first wall of TBM will be exposed to deuterium (D)–T mixture plasma, it is necessary to consider the isotope effects on plasma-driven co-permeation as well.

In this study, the researchers simulated D–T plasma with hydrogen (H)-D mixture plasma. They found that the mixed plasma-driven co-permeation still obeyed the classical mass effects, and the mass effects remained basically constant at different temperatures and particle incidence energies.

At the same time, the existence of hydrogen provided additional channels for D recombination, thus decreasing the D steady state permeation flux.

The transient and steady-state permeation behaviors of mixed plasma-driven co-permeation were investigated in detail.

The study is published in *Nuclear Fusion*.

The data from this study can be used to predict the tritium permeation in the first wall of ITER TBM, providing a basis for the evaluation of tritium permeation in a future fusion reactor.

More information: Cai-Bin Liu et al, Mixed hydrogen isotopes plasma-driven permeation through CLF-1 RAFM steel for ITER HCCB TBM, *Nuclear Fusion* (2022). DOI: 10.1088/1741-4326/ac9193

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