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Experiments and Modeling on Tritium Mass Transfer in Solid Breeding Blanket

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From the viewpoint of fuel control and tritium safety in a DT fusion reactor, it is important to correctly understand the tritium behavior in the blanket system. Previous studies have shown that the tritium generated by the nuclear reaction of lithium and neutron is released as both of HT and HTO from solid breeder materials such as Li2TiO3 and Li4SiO4. The HT / HTO ratio depends on the kind of breeder material and the purge gas. Since the permeation rate of HT through the metal wall is orders of magnitude faster than that of HTO, the permeation rate into the cooling water through the cooling tubes differs depending on the HT / HTO ratio, which affects tritium recovery efficiency. Some of the tritium implanted into the first wall of the blanket is also incorporated to the cooling water via the diffusion in the metal walls such as tungsten and F82H. Since mass transfer phenomena on the plasma facing wall are complicated, and it is difficult in the present to accurately evaluate the tritium transfer rate toward to the cooling water in consideration of this phenomenon correctly. Nevertheless, it is important to work on modeling with the aim of reflecting the results of fundamental experiments and improving the accuracy of tritium behavior prediction. The tritium permeated from the blanket module to the cooling water is transferred to the secondary cooling water via the heat exchanger. For safety management of primary and secondary cooling water and power generation equipment, it is required to evaluate the tritium transfer rate from the blanket modules to the cooling water. In this work, based on the research activities so far, the characteristics of tritium behavior from the blanket to the secondary cooling water in DEMO conditions were summarized.

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