Permeation behavior of two-component hydrogen isotopes in lithium-lead eutectic alloy

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It is important to keep tritium recovery rates high and leak rates low throughout a blanket system for the safe and stable operation of fusion reactors. A Li-Pb eutectic alloy is one of the most promising candidates of liquid blanket for advanced fusion reactors. We have experimentally clarified mass-transfer properties suitable for recovering tritium from Li-Pb by an unsteady permeation method. Our research group has determined mass-transfer data of permeability, diffusivity and solubility of hydrogen and deuterium in Li-Pb. Tritium data can be predicted based on isotope effects between H and D, and tritium recovery rate and inventory of a Li-Pb blanket can be evaluated. It is important to clarify a process of isotope exchange because of the enhancement of tritium recovery rates from Li-Pb.

It is considered that deuterium is absorbed in Li-Pb at the same time as generating tritium. Influences of isotope effects, isotopic exchange reactions and interactions among H, D and T are understood by investigating simultaneous permeation behaviour in the case of hydrogen isotopes coexisting. In the present study, permeation rates of H and D are measured in the case of H and D are present in Li-Pb at the same time. In addition, the equilibrium constants on the surface of Li-Pb and permeabilities of H and D are obtained. The results of isotope effects between H and D are expanded to the tritium.