Effect of Water Formation Reaction on Tritium Release Behavior from Li_4SiO_4

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A tritium release model to explain the tritium release behavior from the solid breeder materials has been developed in Kyushu University, taking into account tritium diffusion in breeder grain, tritium transfer resistance at interfacial layer and various surface reactions. The tritium release curves estimated by this model give good agreements with in-pile or out-of-pile experimental curves from the solid breeder candidates under various purge gas conditions.

It has been observed during above model construction that a considerable amount of adsorbed water exists on the grain surface and that not a little amount of water is produced by the water formation reaction when the purge gas with hydrogen is applied. It is confirmed that two types of bred tritium is released as HT and HTO when water exists in the purge gas. Then, the adequate tritium recovery system is required to recover tritium from HTO to maintain the effective tritium breeding ratio.

The amount of adsorbed water and the capacity of water formation reaction and its release rate from Li_4SiO_4, which has been supplied from FzK, are quantified in this study. It is found that the overall reaction rate of water formation is controlled by the mass transfer resistance at the boundary layer at higher temperature than 750 °C and that it is controlled by the surface reaction at the lower temperature than 600 °C. Then, the rate of water formation reaction of Li_4SiO_4 is so large under the expected blanket temperatures that most hydrogen added to the blanket purge gas changes to water so far as the water formation capacity remains. Tritium release behavior from Li_4SiO_4 and Li_2TiO_3 blanket are compared in this paper using the Kyushu University model and properties obtained in this study under the operational condition of ITER or a commercial reactor.