

Tritium release behavior from tritium breeding pebbles with micro-grains and nano-grains

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In future D-T fusion reactor, self-sufficiency of tritium is one of the critical issues to maintain steady-state operation of the fusion reactor. Li_2TiO_3 and Li_4SiO_4 have been proposed as prominent tritium breeder candidates for solid tritium breeding blanket. As to improve the overall performances of tritium breeders, many advanced tritium breeding materials have been prepared such as core-shell Li_2TiO_3 - Li_4SiO_4 , nano-grain Li_2TiO_3 and so on. Tritium release performance is specifically important due to satisfying tritium self-sufficiency. The release of tritium is affected by many effects including grain size, porosity, adsorption water and so on. In present work, the effects of different grain sizes of Li_2TiO_3 on tritium release were investigated. All tritium breeding pebbles have been irradiated by thermal neutrons in Kyoto University. Tritium release experiment was performed in Shizuoka University. Tritium release spectra were obtained by tritium thermal desorption spectroscopy (Tritium-TDS). Liquid scintillation counter (LSC-5100) was used to calibrate the tritium amount. The kinetic parameters were obtained by KAS model-free-kinetics method.

Tritium retention reduces as the heating temperature goes up. There is large tritium retention in Li_2TiO_3 with grain size of $40\mu\text{m}$ than that of $2\mu\text{m}$ at lower temperature. However, almost all the tritium has been released when the heating temperature is higher than 450°C . The normalized amount of tritium releases from breeders with grain size of $2\mu\text{m}$ and $40\mu\text{m}$ is similar. The temperature of tritium release peak from Li_2TiO_3 pebbles with $40\mu\text{m}$ is higher than that with $2\mu\text{m}$. The activation energy of tritium release from pebbles with large grain size is higher than that with small grain size. Grain size has a significant effect on tritium release. The tritium release performances are compared between the breeders with micro-grains and nano-grains. The temperature of tritium release peak from Li_2TiO_3 pebbles with nano-grains is lower than that with micro-grains. The comprehensive analysis and comparison of tritium release in breeding materials have been performed.