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FTP/P1-15: Effects of the Lithium Concentration on Tritium Release Behaviors from Advanced Tritium Breeding Material Li_2+xTiO_3

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Lithium-enriched Li_2TiO_3, such as Li_2.2TiO_3 and Li_2.4TiO_3 (Li_2+xTiO_3), is considered as one of advanced tritium breeding materials in fusion reactors. Densities of irradiation defects in Li_2+xTiO_3 will increase with increasing lithium concentration. It is expected that tritium is trapped by irradiation defects and its release behavior will be affected by the density of the defects. Therefore, elucidation of enhancement effects of the irradiation defects on tritium release behavior in Li_2+xTiO_3 is an important issue from a viewpoint of tritium recovery

Thermal neutron irradiation was performed for Li_2.0TiO_3, Li_2.2TiO_3 and Li_2.4TiO_3 at the Research Reactor Institute, Kyoto University. The thermal neutron flux was 5.5 x 10ˆ12 n cmˆ-2 sˆ-1 and fluence was 3.3 x 10ˆ15 n cmˆ-2. Thermal Desorption Spectroscopy (TDS) measurements were carried out to investigate the release behaviors of tritium generated in Li_2+xTiO_3. Electron Spin Resonance (ESR) measurements were also carried out to estimated the densities and the annihilation behaviors of irradiation defects introduced by thermal neutron irradiation.

The densities of the irradiation defects in Li_2+xTiO_3 evaluated by the peak areas of the ESR spectra were increased with increasing lithium concentrations. An X-ray diffraction (XRD) showed that the Li_4TiO_4 structure was formed in the lithium enriched samples. The Li_4TiO_4 structure may affect the enhancement to the density of defects for lithium enriched Li_2TiO_3. It was found that the defects for Li_2.0TiO_3 observed by ESR were annihilated around 600 - 800 K, although those for Li_2.2TiO_3 and Li_2.4TiO_3 were annihilated around 400 - 600 K. In addition, two tritium desorption stages were observed at 450 K and 600 K by the TDS measurement. The tritium release in lower temperatures was enhanced with increasing lithium concentration, corresponding to the annihilation temperature region of the defects in Li_2.2TiO_3 and Li_2.4TiO_3. It was concluded that tritium release at the lower temperatures was initiated by the existence of Li_4TiO_4 structure formed in the lithium-enriched Li_2TiO_3. These results indicate that use of lithium-enriched Li_2TiO_3 enables the recovery of tritium about lower temperature compared to Li_2.0TiO_3 and would be an advantage for the fuel recovery from the tritium breeding materials in the fusion reactors.

Country or International Organization of Primary Author

Japan

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Research Reactor Institute, Kyoto University

Primary author: Mr UCHIMURA, Hiromichi (Radioscience Research Laboratory, Faculty of Science, Shizuoka University)

Co-authors: Prof. YAMANA, Hajimu (Research Reactor Institute, Kyoto University); Prof. OKUNO, Kenji (Radioscience Research Laboratory, Faculty of Science, Shizuoka University); Mr TODA, Kensuke (Radioscience Research Laboratory, Faculty of Science, Shizuoka University); Mr KAWASAKI, Kiyotaka (Radioscience Research Laboratory, Faculty of Science, Shizuoka University); Mr KOBAYASHI, Makoto (Radioscience Research Laboratory, Faculty of Science, Shizuoka University); Prof. YASUHISA, Oya (Radioscience Research Laboratory, Faculty of Science, Shizuoka University); Mr TAGUCHI, Tomohisa (Radioscience Research Laboratory, Faculty of Science, Shizuoka University); Prof. FUJII, Toshiyuki (Research Reactor Institute, Kyoto University); Mr MIYAHARA, Yuto (Radioscience Research Laboratory, Faculty of Science, Shizuoka University)

Presenter: Mr UCHIMURA, Hiromichi (Japan)

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