Behavior of hydrogen isotopes in $LiAlO_2$ containing radiation defects

Kenichiro Ikuno [1,*], Takuji Oda[1], Satoru Tanaka[1]

[1]*Department of Nuclear Engineering and Management: The University of Tokyo, Tokyo, Japan*

Understanding the mechanism of tritium release from breeding materials is an important research subject for enhancing the reliability of fuel cycle in nuclear fusion reactors. Previous studies have frequently indicated that radiation defects affect tritium diffusion and desorption behaviors. However, there are few studies observing behaviors of hydrogen isotopes and radiation defects at the same time. In the present study, therefore, we simultaneously performed thermal desorption spectroscopy (TDS), UV-VIS spectroscopy and IR spectroscopy with $LiAlO_2$, in order to indentify factors that determine behavior of hydrogen isotopes interacting with radiation defects in ternary lithium oxides.

Specimens of $LiAlO_2$ <100> single crystals ($10\times10\times1$ mm^3) were irradiated by deuterium ion (D^+) of 300 keV in order to load hydrogen isotopes and radiation defects closely. Then, irradiated specimens were heated to 750°C in a vacuum. During heating, we analyzed desorbed gases by TDS, amounts of defects by UV-VIS, and IR observation of OD by FT-IR.

In TDS, it was observed that deuterium is mainly released as hydrogen molecules (HD, D_2) above 300°C. The desorption temperature range strongly depended on heating condition. By UV spectroscopy, three peaks were observed. The first peak was shape and has the maximum intensity at 220 nm. This peak increased in proportion to the UV irradiation fluence, and decreased very little during heating after the irradiation. The second peak at 230 nm was sharp and the third peak at around 260 nm was relatively broad. These two peaks increased during D^+ irradiation and decreased in the temperature range of 100 to 400°C. These phenomena are considered to be derived from generation of radiation defects by irradiation and recovery of radiation defects by heating. By IR spectroscopy, a broad peak corresponding to O-D vibration was observed in wave number range of 2500~2700 cm^{-1} during and after irradiation. By heating, this peak decreased in the temperature range of 200~500°C. It appeared that release of hydrogen isotopes from $LiAlO_2$ is controlled mainly by diffusion in the bulk, while that from $LiTaO_3$ is by both diffusion in the bulk and recovery of radiation defects.

Corresponding Author:

Author Name:	Kenichiro Ikuno
E-mail Address:	ikuno@flanker.n.t.u-tokyo.ac.jp
Organization:	The University of Tokyo
City, State, Country:	Tokyo, Japan
Telephone Number:	+81-3-5841-6970
Fax Number:	+81-3-5841-6970