DAMAGE ACCUMULATION AND ANNEALING BEHAVIOR IN $LiAlO_2$ IRRADIATED WITH D OR HE IONS

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For establishing an efficient and safe tritium breeding system, it is necessary to quantitatively understand damage accumulation induced not only by PKAs but also by tritons and helium ions resulted from nuclear reactions in solid breeding materials. In this study, accumulation and annealing of ion-induced damage in a $LiAlO_2$ single crystal irradiated with deuterons or helium ions were quantitatively investigated by using ion beam techniques. Besides, change in deuterium or helium retention was also examined, discussing correlation between the damage and the deuterium or helium implanted in $LiAlO_2$.

Samples used were single crystal plates of $LiAlO_2$. The irradiation of ions were made with 10 keV D_2^+ or 10 keV He^+. The number of the disordered atoms and of the D or He retained in $LiAlO_2$ was determined by using Rutherford backscattering spectrometry in channeling geometry aligned for <100> axial direction and Elastic recoil detection analysis.

During D or He irradiation, the dependence of the increase in the amount of disorder on the fluence was stepwise as shown in Figure 1. The number of disordered atoms gradually increased in the initial stage of irradiation. Then, an abrupt increase was observed after the local concentration of the disordered atoms in the damaged depth region increased above approximately 10 at%. Although the number of disordered atoms increased in the same manner for D and He irradiation, it was found that the disordered atoms induced by D irradiation recovered at apparently higher temperature compared to He irradiation (Figure 2). Release of D and annealing of the disorder in $LiAlO_2$ occurred in the same temperature range. On the contrary, release of He was observed at apparently lower temperature compared to annealing of the disorder. From the results of depth profiles of the disorder, it was considered that the implanted D would induce local structural change due to chemical interaction at the end of its trajectory.

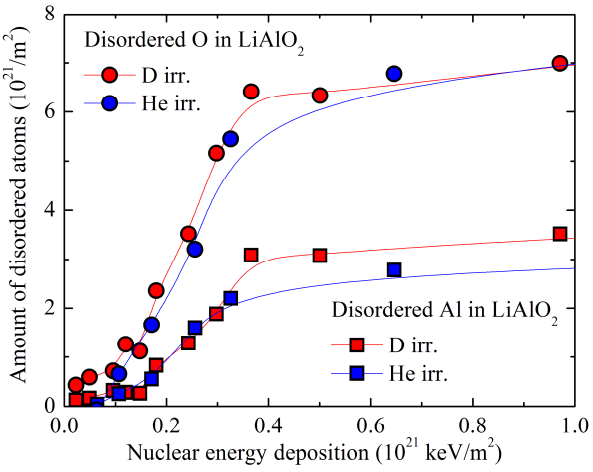

Figure 1: Amount of disordered Al and O atoms from lattice sites induced by D or He irradiation as a function of nuclear energy deposition (fluence).

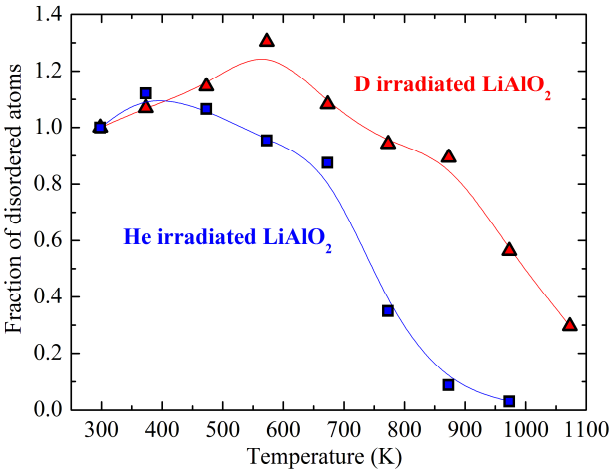

Figure 2: Temperature dependence of the fraction of disordered Al atoms induced by D or He irradiation.