

THERMAL BEHAVIOR OF NOBLE GASES IMPLANTED INTO MINERALS.

T. Futagami, M. Ozima, Geophysical Institute, University of Tokyo, Tokyo, Japan.

S. Nagai, and Y. Aoki, Japan Atomic Energy Research Institute, Takasaki, Gunma, Japan.

In order to understand the thermal behavior of solar wind ions implanted into extraterrestrial materials such as lunar soil grains and interplanetary dust particles, we performed simulated experiments. We irradiated plate specimens of olivine and ilmenite with helium, neon, and argon at room temperature. Irradiation energy was 20, 40, and 200keV. Irradiation dose was 10^{14} , 10^{15} , and $10^{16}/\text{cm}^2$. Implanted noble gases were extracted by stepwise heating in an ultrahigh vacuum. Amounts of gases extracted at each step were measured with a mass spectrometer. The dependence of release temperature of implanted noble gases on irradiation energy and dose was investigated.

For noble gases implanted at the low dose $1 \times 10^{14}/\text{cm}^2$, the release temperature increases with the irradiation energy. This can be explained by considering that the release process may be controlled by thermal diffusion. It was seen that a diffusion coefficient of neon in the (001) direction in olivine is larger than that in the (010) direction. On the other hand, thermal behavior of noble gases implanted at the high dose $1 \times 10^{16}/\text{cm}^2$ is different between helium and neon or argon. Helium implanted at the high dose shows the higher release temperature than helium implanted with the low dose. From observation by a scanning electron microscope, it was implied that helium implanted at the high dose forms a micron-sized bubble. Neon and argon implanted at the high dose show two-peaked release patterns. We interpreted that the low temperature component would be released on recrystallization of surface amorphized by irradiation, while the high temperature component would be released by thermal diffusion through the recrystallized region.