Color centers in NaCl single crystals induced by pulsed intense relativistic electron beams

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1. Introduction

Surface of Europa, a satellite of Jupitar, is known to be covered mainly by ice and there are some a non-ice component with brown color. Recently, a new hypothesis has been proposed that the non-ice component is NaCl irradiated by charged particles in magnetosphere of Jupitar, which shows brown colors by formation of anion vacancies (F-centers) and their clusters[1]. However, there are many other candidates with brown colors so that a novel method to identify the non-ice component is required.

It is thought that the magnitude of magnetosphere of Jupitar may be fluctuating similar to that of the Earth. Using probes with dosimeters in the future, identification of NaCl can be made by the color change with radiation dose fluctuation. Even though there have been numerous results of irradiation effects of NaCl by DC accelerators[1-3], there are no data on formation and recovery behavior of F-centers in NaCl induced by pulsed electron beams. In this research, electron irradiation tests were carried out by pulsed intense relativistic electron beams (PIREBs).

2. Experimental

Single crystals of NaCl with size of 10x10x1 mm were irradiated at room temperature by PIREBs with a peak energy of 6 MeV, a current of -800A, and a pulse width of 70 ns from ETIGO-III in Nagaoka University of Technology, Japan. The irradiation was repeated up to 5 times. The absorbed dose was measured using cellulose triacetate film dosimeter "FTR-125 place on the single crystals. After the

irradiations, the optical absorption of single crystals was measured by an UV-Vis spectrometer. Using the absorption data and the Smakula equation[2], the density of F-centers was calculated.

3. Results and discussion

The density of F-centers are shown in Fig. 1. The production rate of F-centers by PIREB was comparable to those induced by conventional accelerators[3], which are also plotted in Fig. 1. However, it was thought that local temperature might have been raised because of the pulsed irradiation[4].

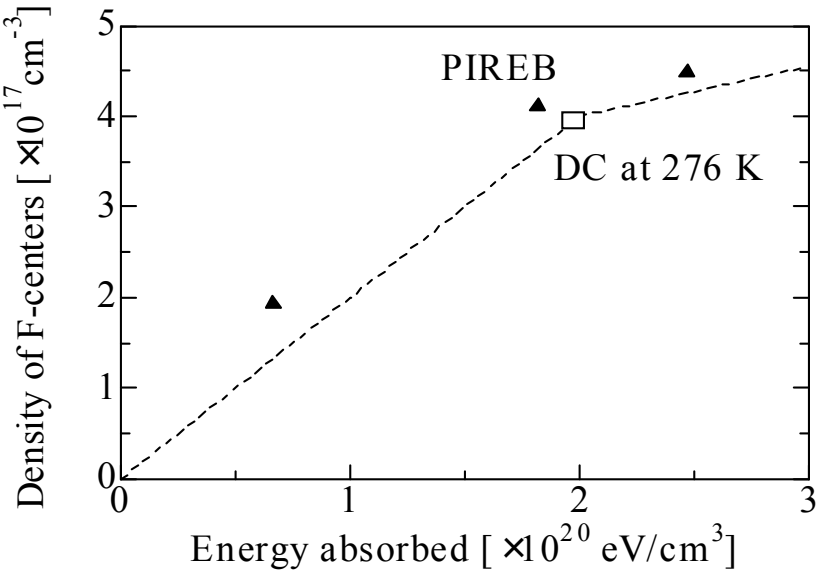

Fig. 1 Density of F-centers plotted against the energy absorbed. Data obtained using a DC accelerator[3] is plotted by dashed line for comparison.

References

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