Radiation damage analysis of high purity SiC by TEM

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Abstract
SiC is a well-known material that has been used in nuclear application due to its excellent mechanical and chemical properties. Exposure to neutron irradiation will degrade the properties through displacement or transmutation effects. Thus, radiation damage microsturctures in SiC need to be determined by TEM.

Keywords: Silicon carbide, Radiation damage, TEM

1. Introduction

Numerous study showed that SiC was swelled significantly at low irradiation temperatures with neutron fluence up to $1x10^{24}$ n/m^2. However, as the irradiation temperatures increase, the swelling decrease due to recovery behavior. Previous study showed that high purity SiC was swelling approximately 1.2 % after exposed to neutron irradiation up to $2.0\text{-}2.4x10^{24}$ n/m^2 at 60-90 ^{o}C. The swelling was expected occur due to point defects instead of loops because of low neutron fluence. Therefore, in this study clarification on type of defects in high purity SiC which exposed to low neutron dose is essential. Other study showed that the similar type of SiC also was completely recovered by post-irradiation annealing up to 1673 K.

2. Experimental

High purity SiC (PureBeta-SiC) was neutron irradiated up to $2.0\text{-}2.4x10^{24}$ n/m^2 at 60-90 ^{o}C. In order to understand the recovery behavior, this specimen was annealed up to 1673 K by heating step with 50 K increment for 6 h. Those specimen were sliced to 300 um and polished to 100 um. Thin foils were prepared by standard dimpling and ion milling techniques. The transmission electron microscope used in the present study was Hitachi H-9000 instrument with accelerating voltage 300kV.

3. Results

Due to low neutron fluence, it is expected that there is no loops will be observed. Thus, the swelling was mainly attributed by interstitial atoms and vacancies. In the case of annealed SiC, where the recovery behavior was completely occurred, formation of loops is anticipated emerged from point defects.

3. Conclusion

Neutron irradiated PureBeta-SiC was swelled mostly due to the point defects and the recovery behavior after post-irradiation annealing is mainly occurred by recombination of interstitial atoms and vacancies.

References

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