Defect Structure and Density Decrease in Neutron-Irradiated Quartz

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Defect Structure and Density Decrease in Neutron-Irradiated Quartz*

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Abstract

Lattice defects in quartz induced by fast neutron irradiation were studied by combined methods of x-ray diffraction and transmission electron microscopy. The developed defect structure is characterized by clusters of interstitials enriched in ruptured silicon atoms. The size and density of the defect clusters increase with increasing dose until mutual interaction occurs, resulting in the formation of a stable, hexagonal-like structure resistant to prolonged annealing at 500°C. In thin crystals the size and volume fraction of the defect clusters are dependent on crystal orientation, being related to the open screw channels of the quartz structure. A relationship was established between the total volume fraction of defect clusters and fractional decrease in density induced by neutron irradiation, accounting satisfactorily for the hydrostatic density measurements reported in the literature.

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