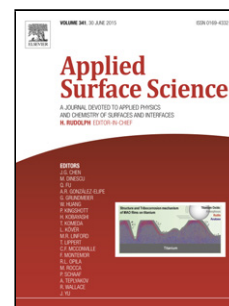


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Modification of mechanical properties of Si crystal irradiated by Kr-beam

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Highlights

Modification of mechanical properties of silicon crystal irradiated by Kr-beam was observed by means of continuous measurements of nano-indentation technique.

Modified mechanical properties shows fluence-dependence.

Young's modulus is more sensitive to crystal to amorphous phase transition while hardness is more sensitive to damage induced by ion beam irradiation.

The depth profile of modified mechanical properties have a potential application of determining the longitudinal size of phase transition region induced by nanoindentation.

ABSTRACT

The application of ion-beam irradiation in fabrication of structures with micro-/nanometer scale has achieved striking improvement. However, an inevitable damage results in the change of mechanical properties in irradiated materials. To investigate the relation between mechanical properties and ion-irradiation damages, nanoindentation was performed on crystalline silicon irradiated by Kr-beam with an energy of 240 keV. Modified Young's modulus and nanohardness, provided from the indentation, indicated fluence dependence. Stopping and range of ions in matter (SRIM) calculation, transmission electron microscopy (TEM) observation, and Rutherford backscattering-channeling (RBS-C) measurement were utilized to understand the irradiation effect on mechanical properties. In addition, the longitudinal size of the phase transition region induced by indentation was firstly evaluated based on the depth profile of modified nanohardness.

Keywords: Young's modulus; hardness; crystalline silicon; ion-beam irradiation

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