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LETTER

Effects of irradiation damage on the back-scattering of electrons: Silicon-implanted silicon

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ABSTRACT

Radiation damage in a (initially crystalline) silicon wafer was generated by microbeam ion implantation with 600 keV Si^+ ions (fluence 5×10^{14} ions/cm^2). To produce micro-areas with different degrees of damage, 14 implantations at different temperatures (between 23 and 225 °C) were done. The structural state of irradiated areas was characterized using Raman spectroscopy and electron back-scatter diffraction. All irradiated areas showed strong structural damage in surficial regions (estimated depth <1 μm), and at implant substrate temperatures of below 130 °C, the treatment caused complete amorphization. Back-scattered electron (BSE) image intensities correlate with the degree of irradiation damage; all irradiated areas were higher in BSE than the surrounding host. Because there were no variations in the chemical composition and, with that, no $\overline{Z}$ contrast in our sample, this observation again supports the hypothesis that structural radiation damage may strongly affect BSE images of solids.

Keywords: Back-scattered electron images, Raman spectroscopy, electron back-scatter diffraction, radiation damage, silicon