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Nanomechanical properties of silicon surfaces nanostructured by excimer las

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Abstract Excimer laser irradiation at ambient temperature has been employed to produce nanostructured silicon surfaces. Nanoindentation was used to investigate the nanomechanical properties of the deformed surfaces as a function of laser parameters, such as the angle of incidence and number of laser pulses at a fixed laser fluence of 5 J cm^{-2}. A single-crystal silicon [311] surface was severely damaged by laser irradiation and became nanocrystalline with an enhanced porosity. The resulting laser-treated surface consisted of nanometer-sized particles. The pore size was controlled by adjusting the angle of incidence and the number of laser pulses, and varied from nanometers to microns. The extent of nanocrystallinity was large for the surfaces irradiated at a small angle of incidence and by a high number of pulses, as confirmed by x-ray diffraction and Raman spectroscopy. The angle of incidence had a stronger effect on the structure and nanomechanical properties than the number of laser pulses.

PACS
62.25.-g Mechanical properties of nanoscale systems
61.82.Rx Nanocrystalline materials
61.80.Ba Ultraviolet, visible, and infrared radiation effects (including laser radiation)
68.35.Gy Mechanical properties; surface strains
78.30.Am Elemental semiconductors and insulators
78.67.Bf Nanocrystals and nanoparticles

Subjects
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