OPTICAL AND SENSITIVE PROPERTIES OF NANOSTRUCTURED SILICON IRRADIATED WITH HIGH-ENERGY PARTICLES (PROTONS, α-PARTICLES, AND HEAVY IONS)

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S u m m a r y

For gas sensorics needs, an attempt has been made to modify a silicon surface by accelerated charged particles which form tracks. The influence of irradiation with 6.8-MeV protons, 27.2-MeV α-particles, and heavy ions (^{40}Ar, ^{131}Xe, and ^{209}Bi) on the optical and adsorption properties of n-Si and SiO_2/Si structures with nanopores has been studied. Scanning electron microscopy and atomic-force microscopy were used to analyze the surface morphology. The optical constants n and k of specimens before and after irradiation were determined making use of multiangle monochromatic ellipsometry. The modification of optical constants of n-Si specimens subjected to the p^+ or α-particle irradiation was found to be caused by the destruction of a near-surface layer of the material and to be accompanied by an enhancement of the surface roughness. The irradiated structures revealed a higher sensitivity to the adsorption of ammonia and acetone molecules. The optical constants of SiO_2/Si structures were shown to depend on the material porosity. The fill factor of a SiO_2 layer irradiated with ^{131}Xe and ^{209}Bi ions was calculated. The most developed pore surface was found after the irradiation of silicon with ^{209}Bi ions. Accordingly, the largest changes of optical constants were observed in specimens irradiated with bismuth ions.