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Structure, impurity composition, and photoluminescence of mechanically polished layers of single-crystal silicon

Batalov R., Bayazitov R., Khusnullin N., Terukov E., Kudoyarova V., Mosina G., Andreev B., Kryzhkov D.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The introduction of optically active defects (such as atomic clusters, dislocations, precipitates) into a silicon single crystal using irradiation, plastic deformation, or heat treatment has been considered a possible approach to the design of silicon-based light-emitting structures in the near infrared region. Defects were introduced into silicon plates by traditional mechanical polishing. The changes in the defect structure and the impurity composition of damaged silicon layers during thermal annealing (TA) of a crystal were examined using transmission electronic microscopy and x-ray fluorescence. Optical properties of the defects were studied at 77 K using photoluminescence (PL) in the near infrared region. It has been shown that the defects generated by mechanical polishing transform into dislocations and dislocation loops and that SiO2 precipitates also form as a result of annealing at temperatures of 850 to 1000°C. Depending on the annealing temperature, either oxide precipitates or dislocations decorated by copper atoms, which are gettered from the crystal bulk, make the predominant contribution to PL spectra. © 2005 Pleiades Publishing, Inc.

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