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Crystallographic and thermographic analysis of phase transition of zirconium dioxide induced by dental processing

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Zirconium dioxide is now the material widely used in the dental prosthetics. However, the improper mechanical treatment can induce changes in the microstructure of zirconium oxide. From the viewpoint of mechanical properties and performance the phase transitions of ZrO_2 from the tetragonal to the monoclinic, induced during mechanical processing, are particularly undesirable [1].

The aim of this study was to evaluate the phase transitions of dental zirconium dioxide induced by mechanical treatment by the use of scanning electron microscopy and powder diffraction. For mechanical working of material were used various types of of drills used presently in dentistry. At the same time the surface temperature was monitored during milling using a thermal imaging camera.

Diffraction analysis allowed to determine the effect of temperature and mechanical processing methods on the scale of induced changes. The observed phase transition (to the monoclinic phase) were correlated with methods of mechanical processing.

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The influence of Mn_4Si_7 inclusions dimension on silicon matrix strain state in Si:Mn

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Czochralski and Floating-zone 001-oriented silicon single crystals were implanted with 160 keV Mn^+ ions to a dose of 1×10^{16} cm^{-2} and next annealed for 1 h at temperatures up to 800 °C. As it has been reported earlier Mn_4Si_7 nanoinclusions are created during the temperature processing. Using TEM method as well as by analysis of X-ray diffuse scattering it has been found that the sizes of the inclusions increase with annealing temperature, whereas their concentration decreases [1].

The aim of the present work is to determine the influence of the Mn_4Si_7 inclusions on the silicon matrix strain state. Unsymmetrical shape of 004 X-ray diffraction peaks shows that there is a distribution of the matrix lattice parameter. This effect disappears after 800 °C processing. A strong correlation between the sizes of nanoinclusions and the matrix strain state has been found. When the sizes are below of 15 nm, the tensile strain occurs but when the particle sizes exceed 20 nm, they become incoherent in respect to the silicon matrix.

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