

Silicon oxide in Si---Si bonded wafers

C. Himcinschi^{a,✉}, A. Milekhin^{a, b}, M. Friedrich^a, K. Hiller^c, M. Wiemer^c, T. Gessner^c, S. Schulze^a and D. R. T. Zahn^a

^a Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz, Germany

^b Institute of Semiconductor Physics, 630090 Novosibirsk, Russia

^c Zentrum für Mikrotechnologien, Technische Universität Chemnitz, D-09107 Chemnitz, Germany

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Abstract

The properties of surface and buried interface silicon oxide layers in low- and high-temperature Si---Si bonded wafers, were investigated using infrared spectroscopy, spectroscopic ellipsometry (SE) and high resolution transmission electron microscopy (HRTEM). Infrared transmission spectra show the absorption by Si---O---Si vibrations originating from surface and interface silicon oxide. To distinguish the contribution of surface and buried interfaces oxide in the spectra, the surface oxide was removed by chemical etching. The interface oxide thickness was calculated from curve fitting of infrared transmission spectra of the etched bonds. An excellent agreement of values of the interface oxide thicknesses determined using this method with those obtained from HRTEM measurements was found. The behaviour of longitudinal and transversal optical (LO and TO) phonons in surface silicon oxide was analysed. The frequency position of TO and LO modes shifts towards higher energy and the LO-TO splitting decreases upon annealing. This behaviour can be explained in terms of a thermal relaxation model.

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 Corresponding author. Tel.: +49-371-531-4807; fax: +49-371-531-3060; email: c.himcinschi@physik.tu-chemnitz.de