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Symmetry in optical properties: Silicon temperature dependent dielectric function M.J.G. LEE, University of Toronto, Canada, A. SHKREBTII, University of Ontario Institute of Technology, Oshawa, Canada, W. RICHTER, M. DRAGO, Technical University of Berlin, Germany, G. NICHOLLS, Z.A. IBRAHIM, University of Ontario Institute of Technology, Oshawa — The dielectric function of the indirect gap semiconductor bulk Si has been measured experimentally in the temperature range 300 K to 1270 K, and has been modeled theoretically in the range 0 K to 1300 K. The observed low temperature optical peak at 1.1 eV is below the direct optical gap of the ideal lattice (about 3.0 eV). We attribute this peak to zero-point lattice vibrations which, by reducing the translational symmetry, allow direct optical transitions below the direct gap of the ideal lattice even at 0 K. A lattice dynamical calculation in which zero-point vibrations are included gives a good account of the temperature dependencies of the energies and the widths of the peaks in the observed dielectric function of bulk Si over the whole temperature range. We conclude that the dielectric function of bulk Si is very sensitive to the breaking of translational symmetry by the thermal motions of the atoms, and that zero-point vibrations play an essential role in a quantitative description of the dielectric function of bulk Si. The research was supported by Sfb 296 and NSERC Discovery Grants.

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