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Zero-point band gap renormalization and superconductivity in diamond MANUEL CARDONA, Max-Plank-Institut für Festkörperforschung —

During the past decade the zero-point renormalizations of band gaps have been determined both experimentally and theoretically for many semiconductors. Tetrahedral materials containing elements of the second row of the periodic table C,N,O) have been shown to have fundamental gap renormalizations considerably larger (up to one order of magnitude) than those containing only other elements. Diamond, for instance, has a renormalization of $\sim$ 500meV as compared with 60 meV for silicon and germanium. This effect has been attributed to the lack of d-electrons in the core of the carbon atoms [1]. Superconductivity, with T_c up to $\sim$9K, has been recently discovered in heavily boron doped diamond [2,3]. It will be conjectured that this phenomenon is related to the large coupling between the optical phonons and the holes at the top of the valence band, which is also related to the large band gap renormalization.An estimate of $T_c$based on available values of the hole-phonon deformation potential $d_o$and of the hole effective masses will be shown to explain the experimental values found for diamond. The corresponding $T_c$for Si and Ge should be either very small or nonexistent.

1. M.Cardona Solid State Commun. **133**, 3 (2004)
2. E.A. Ekimov et al., Nature **428**, 542 (2004)
3. Y.Takano et al., Appl. Phys. Lett. **85**, 2851 (2004)

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