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Variation of electron-phonon coupling in group IV elemental semiconductors[1] NANDAN TANDON, LISA PUGSLEY, L. R. RAM-MOHAN, Physics Department, Worcester Polytechnic Institute, Worcester, MA — Electron-phonon (e-ph) coupling determines the transfer of energy from hot electrons to the lattice, resulting in the heating of devices. In the current treatments, the e-ph coupling is determined within the long-wavelength phonon approximation. In this work, we consider the e-ph coupling and its variation over the entire Brillouin zone (BZ). The electronic structure and the full phonon dispersion are evaluated with the phonon dispersion calculated using the density functional perturbation theory (DFPT). The e-ph coupling is evaluated using maximally localized Wannier functions and generalized Fourier interpolation to generate e-ph matrix elements on arbitrary grids. Examples of specific initial electron momentum both in the valence and in the conduction bands are presented, together with the variation of the e-ph coupling over the entire BZ associated with the specific initial carrier momenta. We observe variations of up to about 400meV in Diamond and $50 - 100$meV in Silicon and Germanium for the evaluated e-ph matrix element. We comment on the consequence of this variation on the carrier lifetimes in these materials.

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