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Electron-Phonon interactions in Isotopic Diamond Superlattice[1]
YUKI BANDO, MASAYUKI TOYODA, SUSUMU SAITO, Department of Physics, Tokyo Institute of Technology — In isotopic diamond superlattices where ^{12}C and ^{13}C diamond layers are alternately stacked, the confinement of carriers to ^{12}C diamond layers has been demonstrated experimentally. It is expected that the confinement of carriers is caused by the difference of strong electron-phonon interactions between two isotopic diamond layers. However, the details of the phenomena have not been revealed theoretically nor experimentally. The objective of our study is to reveal the electronic structure including electron-phonon interactions and isotope effects in isotopic diamond superlattices. We compute the dependence of lattice vibrations on the thickness of each isotopic diamond layer based on density functional perturbation theory to estimate the effect of electron-phonon interactions. We also compute the electron-phonon interactions based on Allen-Heine-Cardona theory. As a result, it is found that the characteristic electron pockets in diamond are anisotropically modified in thin isotopic diamond superlattices where each isotopic diamond layers are stacked along [001] direction.

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