Long-Wavelength Nonpolar Phonons in Semiconductor Heterostructures

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Phenomenological long-wavelength models have been widely employed with good results even for relatively shorter wavelengths. Their mathematical simplicity helps to derive analytical results and visualize the physics of different problems. Employing a phenomenological long-wavelength approach recently developed (F. de León-Pérez and R. Pérez-Alvarez, Phys. Rev. **B 61**, 4820 (2000)) both acoustic and optical phonons in nonpolar heterostructures are studied. We analyze the coupled longitudinal and transverse atomic oscillations. Any phonon mode is calculated without additional effort respect to high symmetry directions. A simple analytical expression for the dispersion relation in superlattices is obtained. These facilities are not shown by the traditional treatments. We examplificate numerically in unstrained short period isotopic Ge superlattices and quantum wells and strained short period Si/Ge superlattices. A good agreement with the results in other works is achieved.