

## EFFECT OF ELECTRON-PHONON SCATTERING MECHANISMS ON FREE-CARRIER ABSORPTION IN QUASI-ONE-DIMENSIONAL STRUCTURES

Chhi-Chong Wu<sup>1</sup> and Chau-Jy Lin<sup>2</sup>

<sup>1</sup> Institute of Electronics, National Chiao Tung University, Hsinchu, Taiwan

<sup>2</sup> Department of Applied Mathematics, National Chiao Tung University, Hsinchu, Taiwan

The free-carrier absorption in ultrathin wires fabricated from III-V semiconductors such as n-type InSb has been investigated for the case where the electrons are scattered either by polar optical phonons or acoustic phonons. We study the interaction of longitudinal polar optical phonons with electrons and have neglected the interaction between electrons and transverse optical phonons in solids. The energy band of electrons in semiconductors is assumed to be nonparabolic. The scattering mechanisms of the interaction between electrons and phonons we consider here come from [a] electron-polar-optical-phonon scattering, [b] electron-acoustic-phonon scattering, and [c] piezoelectric scattering in III-V semiconductors. When the carriers in semiconducting wires are scattered by the acoustic phonons, the effect of acoustic phonon scattering on the free-carrier absorption coefficient for both deformation-potential coupling and piezoelectric coupling in semiconductors are considered. Results are shown that the free-carrier absorption coefficient for the deformation-potential coupling is much larger than that for the piezoelectric coupling. Thus the effect of piezoelectric scattering in wires due to the interaction of electrons and acoustic phonons can be neglected. It is also shown that the free-carrier absorption coefficient for the electron-polar-optical-phonon scattering is smaller than that for the electron-acoustic-phonon scattering. However, the free-carrier absorption coefficient increases quite slowly with the photon frequency for the electron-acoustic-phonon scattering. This is not the same result as that for the quasi-two-dimensional semiconducting structures [1].

[1] C. C. Wu and C. J. Lin, *J. Appl. Phys.* **79**, 781 (1996).