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Tuning the hole mobility in InP semiconductor nanowires[1]
MARIAMA REBELLO SOUSA DIAS, UFSCar Ohio University, ADALBERTO PICININ, VICTOR LOPEZ-RICHARD, UFSCar, SERGIO E. ULLOA, Ohio University, LEONARDO K. CASTELANO, JOSÉ PEDRO RINO, GILMAR E. MARQUES, UFSCar — Transport properties of holes in InP nanowires were calculated considering the effect of temperature and the presence of realistic strain fields. The mobility of holes is obtained analytically by considering electron-phonon interaction via deformation potential through longitudinal optical (LO) phonons. Using molecular dynamics with realistic force potentials, we simulate nanowire structures and the associated phonon density of states; the structures show effects of LO phonon energy renormalization due to the reduced dimensionality and variation of the phonon lifetimes important for carrier mobility. Our mobility calculations include heavy and light hole subbands in a Luttinger Hamiltonian formalism and consider how the valence band ground state changes between light- and heavy-hole character, as both the strain field configuration and the nanowire size are changed. Depending on the dimensions and characteristics of the nanowire, we find interesting sudden changes in the mobility, which arise with the onset of a resonance between the LO phonon frequencies and the subband separation between the ground and first hole state. We will present the effect of strains and temperature on this resonant behavior and discuss the consequences for carrier mobility in these systems.

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