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Quantum well subbands in high conduction band offset heterostructures[1] YONG-HEE CHO, ALEXEY BELYANIN, Department of Physics, Texas A&M University, College Station, TX — High conduction band offset heterostructures are becoming the material of choice in quantum cascade lasers and other intersubband devices operating in the short-wavelength range below ~ 3 μm. To design these devices one needs to determine the position of highly excited subbands and lateral valleys located at energies comparable to band gap above the bottom of the conduction band in the quantum wells (QWs). In this case standard methods of band structure calculation based on the one band model with the Γ edge effective mass and non-parabolicity correction or on simplified k.p models become inadequate. We calculate the confinement energies in the conduction band of high band offset QWs, such as InGaAs/AlAsSb or InAs/AlSb, using 30-band k.p band structures over the entire first Brillouin zone. We discuss the effect of lowest lateral valleys of the conduction band on the QW confinement energies. We compare the results of the rigorous treatment with that obtained using various versions of the effective mass approximation with the energy-dependent electron mass. Implications for the device design and performance are discussed.

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