

Homework Assignment on Quantum Mechanical Reflections

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It is well known that in deep submicrometer MOSFET devices that will be discussed later in this series of lectures, the substrate densities have to be very high to avoid the so-called punchthrough effect. Under zero drain bias, and to first order, the conduction band in these structures can be approximated by a potential step, the height of which is on the order of 0.1 eV in the inversion condition and the width of the barrier corresponds to the gate-length of the device. One can show that there are significant quantum-mechanical reflections for carriers with energy larger than the barrier height in these structures. Assume that the barrier width is 40 nm, 30 nm, 20 nm and 10 nm. Plot the discrete energy spectrum above the conduction band and the transmission coefficient variation for each of the four barrier widths. Comment on the nature of the energy spectrum and the variation of the transmission coefficient which gives us idea on the importance of quantum-mechanical reflections in each of the 4 structures being considered. (Use the Resonant Tunneling Diode Lab for this exercise).