

Structure of Transverse Electron Current in Resonant Tunneling Diodes and Breakdown of Tsu–Esaki Formula

Titus Sandu (NanoFAB Center, University of Texas at Arlington, Arlington, Texas 76019), Gerhard Klimeck (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109), Wiley P. Kirk (NanoFAB Center, University of Texas at Arlington, Arlington, Texas 76019)

We studied the transverse structure of electron current in resonant tunneling diodes (RTDs). The coherent transport of electrons, which is described by Tsu–Esaki formula, induces zone–center current flow of electrons in RTDs. By comparison, the coherent transport of holes has off–zone–center current flow due to the mixing of heavy and light holes. By including incoherent scattering we show that, in general, electron current flow is also off–center, i.e. the hole behavior is extended to electrons and is related to the breakdown of the Tsu–Esaki formula. Oblique flow is due to incoherent scattering represented by interface roughness and acoustic phonons.