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Zener Tunneling: Correspondence between Quantum and Semi-Classical Formalisms KARTIK GANAPATHI, SAYEEF SALAHUDDIN, University of California Berkeley — The resurgence of interest in band-to-band tunneling has been due to its usefulness in overcoming the 60 mV/decade limit in turn-on characteristics of a MOSFET thereby providing path for lowering the operating power. The expression due to *Kane*, for calculating transmission coefficient and current due to Zener tunneling in a $p-n$ diode, has been extensively used over the years for explaining experimental tunneling characteristics. While this closed form expression relates tunneling probability with simple quantities like bandgap, effective mass, electric field etc., being a formula based on semi-classical approximation, it is valid strictly in the low-field regime. With finite size effects playing significant role in ultra small device dimensions, this approximation breaks down and one needs to have a full quantum mechanical treatment of the tunneling problem with a realistic band-structure. We report a numerical simulation of this problem within the NEGF formalism with a tight-binding Hamiltonian wherein the extent of validity of Kane's formula is examined. We also discuss how Kane's parameters should be altered and interpreted in high field region. The results are compared with experimental data in two different systems – InAs $p^+ - n^+$ and GaN/AlGaN heterojunction tunnel diodes.

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