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Leakage current in deca-nano MOSFET by surface state hopping[1]

HASSAN RAZA, EDWIN KAN, School of Electrical and Computer Engineering, Cornell University Ithaca NY 14853 — Si surface states have been a topic of recent study [Nature 439, 703 (2006), PRB 76, 045308 (2007)]. In this work, we present transport calculations through these surface states, which result in a two-dimensional system. Among the systems being considered are: (1) pi and pi* states on Si(100):(2x1) surface with asymmetric dimer reconstruction, and (2) dangling bond wires along and perpendicular to the dimer row direction. Previously, we have reported the electronic structure of these systems in PRB 76, 045308 (2007). Here, we show that these states can give rise to significant current densities and hence may contribute to subthreshold leakage. Furthermore, the transport depends on the location of Fermi level with respect to the band edge and hence on the Fermi level pinning. We use EHT (extended Huckel theory) for the electronic structure and NEGF (non-equilibrium Green's function) formalism for the mean-field quantum transport. EHT has been applied to Si bulk and surfaces and gives quantitative agreement with experiments, e.g. band gap and band dispersions.

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