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Stochastic current switching behavior in semiconductor superlattices[1] STEPHEN TEITSWORTH, HUIDONG XU, Duke University —

Numerical simulation results are presented for a discrete drift-diffusion model that describes electronic transport in weakly-coupled semiconductor superlattices under voltage bias and also includes shot noise in the tunneling currents. Sequential resonant tunneling between quantum wells is the primary conduction mechanism and noise terms are treated as delta-correlated in space and time. We study the response of this system to abrupt steps in applied voltage in a range for which the current-voltage characteristics exhibit bistability. The system switches from a metastable state to a stable state with a stochastically varying delay time, a process corresponding to relocation of charge density from one (critical) quantum well to an adjacent one. We find that the mean delay time τ varies as $\ln \tau \propto V - V_{th}^{3/2}$ where V and V_{th} denote, respectively, the system voltage and the voltage at the boundary of the bistability range [1]; τ also depends exponentially on the cross-sectional area of the superlattice. An effective one-dimensional potential energy is constructed for the charge density in the critical quantum well. We find that noise contributions of the quantum wells far from the critical well have a significant effect on the switching process. [1] O. A. Tretiakov and K. A. Matveev, Phys. Rev. B. **71**, 165326 (2005).

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