Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Reduction of Dark Current in Germanium Quantum Dot Infrared Photodetector SIGUANG MA, SONG TONG, HYUNG-JUN KIM, JOO-YOUNG LEE, K. L. WANG, Device Research Laboratory, Department of Electrical Engineering, University of California at Los Angeles — We present theoretical and experimental studies aimed for the reduction of dark current of self-assembled Ge/Si quantum dot infrared photodetector. P-i-p structures were grown with p-type doped Ge dots embedded in the intrinsic Si region using p^+-type Si (100) substrates. A $Si_{1-x}Ge_x$ thin layer with high Ge content was inserted in the active region and the quantum well formed in the valence band acts as a current barrier layer (CBL). In simulation, the modification of the hole masses due to strain effects was determined by a k·p band structure calculation. Quantum confinement, thermionic emission and scattering process were taken into consideration for carrier transport model in the quantum well region. Simulation study showed that the leakage current can be reduced up to three orders of magnitude. Experiments were carried out to verify the simulation results. The photocurrent to dark current ratio with respect to bias was examined to show the impact of CBL on device performance.

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Date submitted: 06 Dec 2004 Electronic form version 1.4