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Quantum-Dot Photodetectors: High Sensitivity due to Controllable Kinetics[1] ANDREI SERGEEV, LI-HSIN CHIEN, NIZAMI VAGIDOV, VLADIMIR MITIN, SUNY at Buffalo — Comparing to the quantum wells, the quantum-dot structures provide more opportunities to control electron kinetics and to optimize operating regimes of quantum-dot photodetectors. At room temperatures, the photoelectron capture in quantum-dot structures is determined by the electron diffusion in the potential of intentionally or unintentionally charged quantum dots1. Therefore, the capture time can be drastically increased by a proper choice of geometry of the quantum-dot structure and modulation doping. Suppression of capture processes provides longer lifetimes of photoelectrons, thus increasing the photoconductive gain and responsivity. Here we exploit a model of the QD detectors operating at room temperatures and study electron diffusion in the self-consistent field of potential barriers surrounding quantum dots. Using the Monte-Carlo method and analytical evaluations, we investigate photoelectron capture and transit processes as functions of the quantum dot positions, sensor geometry, and external electric field applied. Finally, we calculate the photoconductive gain and discuss the optimal structures and regimes. [1] A. Sergeev, V. Mitin, and M. Stroscio, Physica B 316-317, 369 (2002).

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