Seminarankündigung

Dienstag, 29. September 2009

17:15 Uhr

WSI, Seminarraum S 101

„Quantum-dot photodetectors: In search of optimal design for room-temperature operation„

Comparing to the quantum wells, the quantum-dot structures provide more possibilities to control photoelectron kinetics and in this way to improve photodetector characteristics, such as photoconductive gain, responsivity, noise equivalent power, and operating temperature. Recently infrared quantum-dot photodetectors (QDIPs) have shown the detectivity of 10^7 – 10^8 cmHz$^{1/2}$/W and demonstrated their strong potential for various commercial applications. However, resources for further improvement of QDIPs based on tradition structures are very limited. In this presentation we will review novel ideas in QDIP design and identify the physical mechanisms that control the QDIP characteristics.

At room temperatures, the photoelectron capture in quantum-dot structures is determined by the electron diffusion in complex relief of potential barriers around intentionally or unintentionally charged quantum dots. Photo-excitation of carriers from dots is determined by intradot kinetic processes, where electron-electron interaction strongly dominates over the electron-phonon scattering. Thus, both photoelectron excitation and capture turn out to be very sensitive to the electron population of dots, which may be controlled by a proper choice of the structure geometry and modulation doping.

To optimize quantum-dot photodetectors for room temperature operation, we develop a detailed model of kinetic and transport processes in quantum dot structures. Monte-Carlo method is used to investigate nonequilibrium effects in strong electric fields. The cases of individual as well as collective barriers for the dots are considered. Results of our simulations demonstrate that specific design and operating regimes provide wide possibilities for manageable (adaptive) kinetics of photoelectrons, which in turn allows significant improvements in detector performance.

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