

# The photocurrent of resonant tunneling diode controlled by the charging effects of quantum dots

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**Abstract** We experimentally studied the photocurrent of AlAs/GaAs/AlAs double barrier resonant tunneling diode (RTD), which is composed of an InAs layer of self-assembled quantum-dots on top of AlAs barrier layer. It is found that the charging InAs quantum dots can effectively modulate the carrier transport properties of the RTD. Moreover, we also found that the resonant tunneling current through a single energy level of an individual quantum dot is extremely sensitive to the photo-excited holes bound nearby the dot, and the presence of the holes lowers the electrostatic energy of the quantum dot state. In addition, it is also observed that the photocurrent behaves like step way with the individual photon pulse excitation when the illumination is low enough. The experiment results well demonstrated the quantum amplified characteristics of the device.

**Keywords** Quantum dot · Resonant tunneling diode · Single photon detection

## 1 Introduction

Single-photon detector has triggered extensive interests due to its promising applications in the area of imaging, diagnosis, chemical analysis and optical quantum information in the past few years [Schettini et al. \(2007\)](#), [Ramond et al. \(2007\)](#), [Shields et al. \(2000\)](#), [Hadfield \(2009\)](#),

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