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Ultrafast Carrier and Conductivity Dynamics in Rh-doped InGaAs-based Multi-Quantum-Well Heterostructures

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Abstract

This study presents Rh-doped InGaAs-based multi-quantum-well (MQW) heterostructures designed for ultrafast photoconductive antennas in terahertz (THz) time-domain spectroscopy. The structure includes a Rh-doped InGaAs quantum well, designed for carrier trapping, between high-mobility InGaAs layers and InAlAs barriers. Optical-pump optical-probe (OPOP) and optical-pump THz-probe (OPTP) measurements show ultrafast carrier dynamics, with 1/e lifetimes ranging from 0.36–0.75 ps (OPOP) and 0.62–1.20 ps (OPTP). These reflect rapid carrier thermalization, relaxation, and trapping and confirm the potential of Rh-doped MQWs as photoconductive THz emitters and receivers.