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Terahertz Ionization of Highly Charged InGaAs Quantum Posts
CHRISTOPHER MORRIS, DOMINIK STEHR, TUAN-ANH TRUONG, HYOCHUL KIM, PIERRE PETROFF, MARK SHERWIN, University of California Santa Barbara, CRAIG PRYOR, University of Iowa — Quantum posts (QPs) are quantum dot based nanostructures grown by MBE. They form short $In_{.4}Ga_{.6}As$ cylinders embedded in an $In_{.1}Ga_{.9}As$ quantum well (QW). Terahertz absorption measurements are performed on 30 nm high QPs with ∼6 electrons per post and a charge density of ∼2.4x10^{11}/cm^2 in the surrounding well. Comparison of spectra from QP and reference QW samples shows an absorption feature due to the QPs absent in the QW sample. Temperature dependent measurements show this absorption is due to electrons in the QPs. 8 band k.p calculations of post and well energies are performed as a function of the number of electrons in the posts, and the absorption is determined to be due to an "ionizing" transition from the posts to the well. The highest filled QP state absorbs a terahertz photon, transitioning to a weakly bound unfilled post state ∼20 meV higher. From there, the electron quickly scatters into the two dimensional electron gas in the quantum well matrix. Coulomb repulsion from QP electrons locally depopulates the quantum well states, leaving open states for the QP electrons. QPs represent a promising structure for investigation of Coulomb blockade physics and ionizing transitions in artificial atom systems.

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