Nonequilibrium Green’s Function Theory of Resonant Steady State Photoconduction in a Double Quantum Well FET subject to THz Radiation at Plasmon Frequency

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ABSTRACT

Recent experimental observations by X.G. Peralta and S.J. Allen, et al [1] of dc photoconductivity resonances in steady source-drain current subject to terahertz radiation in a grid-gated double-quantum well FET suggested an association with plasmon resonances. This association was definitively confirmed for some parameter ranges in detailed electrodynamic absorbance calculations by V.V. Popov, et al [2]. In this paper I propose that the reason that the dc photoconductance resonances match the plasmon resonances in semiconductors is based on a nonlinear dynamic screening mechanism. In this, I employ a shielded potential approximation that is nonlinear in the terahertz field to determine the nonequilibrium Green’s function and associated density perturbation that govern the nonequilibrium dielectric polarization of the medium. This “conditioning” of the system by the incident THz radiation results in resonant polarization response at the plasmon frequencies which, in turn, causes a sharp drop of the resistive shielded impurity scattering potentials and attendant increase of the dc source-drain current. This amounts to disabling the impurity scattering mechanism by plasmon resonant behavior in nonlinear screening.

REFERENCES


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