Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Anomalous Mobility Enhancement via PPC of a GaAs/AlGaAs 2DEG[1] YUN SUK EO, STEVEN WOLGAST, ÇAĞLIYAN KURDAK, Randall Laboratory of Physics, University of Michigan, LOREN PFEIFFER, KEN WEST, Department of Electrical Engineering, Princeton University — We report the unusual transport behavior of a two-dimensional electron gas (2DEG) in a δ-doped $GaAs/Al_xGa_{1-x}As$ heterostructure. Typically, the carrier density can be varied with a gate voltage or via the persistent photoconductivity (PPC) effect. The relationship between carrier density and mobility has often been expressed with the empirical relation $\mu \sim n^{\alpha}$, where α contains scattering mechanism information and typically ranges between 1 and 2. Here, we study the carrier density and mobility using gating techniques and the PPC effect with infrared and white light in small incremental exposures. At 4.2K, we find that the addition of a gate structure greatly reduces the achievable mobility. For PPC, we find that after white exposures, α can become unusually large. At 0.3 K, we observe an unusual decrease in carrier density, accompanied by an enhancement in mobility ($\alpha < 0$) after repeated exposures of light. When the mobility is further enhanced by PPC, the 2DEG exhibits parallel conduction in its doping layer, and the transport becomes no longer controllable. However, the drifting mobility and carrier density eventually settle to reproducible values that are independent of the light increment history or other initial conditions.

[1]The project was supported by NSF grant #DMR-1006500, and in part by the Gorden and Betty Moore Foundation, the NSF MRSEC program #DMR-0819860, and the NSF-funded Lurie Nanofabrication Facility.

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Date submitted: 17 Nov 2012 Electronic form version 1.4