Optical Excitation of Donor-Site Lattice Defects in AlGaAs Devices

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Most radio astronomical observations in the microwave spectrum require low-noise amplifiers, cooled to cryogenic temperatures, to minimize thermally-generated noise that may otherwise swamp the weak celestial signals. However, AlGaAs/GaAs Heterostructure FETs (HFETs) exhibited a non-linear transconductance and a degraded noise performance at cryogenic temperatures.

This degraded performance prompted an investigation by Marian Pospieszalski of National Radio Astronomy Observatory's Central Development Laboratories This work indicated there exists a beneficial light sensitivity in the HFETs. He discovered that illumination of the HFETs with 650nm light improved noise performance and restored transconductance performance to near-theoretical values. The mechanism to explain this behavior was beyond the scope of the 1985 paper.

This paper characterizes the source of the non-linear transconductance and the degraded noise performance described in the Pospieszalski study. The effect of persistent photoconductivity is then quantified and used to develop a model to describe the behavior of AlGaAs HFETs at cryogenic temperatures with and without illumination.