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Numerical Studies into the Possibility of ″Lock-On″ in a GaN Photoconductive Switch for High Power Applications

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“Lock-On”was reported for GaAs and InP Photoconductive Semiconductor Switches (PCSS) over two decades ago [1]. More recently, focus has shifted to the GaN wide bandgap material for potential PCSS applications. Given that GaN is a direct bandgap material like GaAs, it can also be expected to support Lock-On. Potential benefits include an ability to withstand larger voltages and power, very low dark currents, and reduced heating due to larger thermal conductivity. However, Lock-On in GaN has not been observed to date. Here, a fundamental assessment of the potential for Lock-On in GaN is reported based on physics-based numerical modeling.
A one-dimensional time-dependent model is developed and discussed. Field-dependent carrier velocities have been taken from the literature [2]. A drift-diffusion model is used to implement mobile carrier transport. Trapping-detrapping dynamics are included on the basis of rate equations, with trap-to-band impact ionization being an important and separate process. As detailed information regarding traps (their densities and energy levels), and impact ionization rates is not yet fully available, various possibilities are probed and will be reported. Our contribution also includes investigations of hole injection, photon recycling, and field dependent multiphonon trap emission to predict the potential ″Lock-On″ scenarios. For completeness, we will also discuss Lock-On in GaAs based on the model developed with suitable comparisons to experimental data.

References:

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