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3D Quantum Simulation of a HEMT Device Performance

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Abstract : We present a simulation of a HEMT (high electron mobility transistor) structure with and without a field plate. We extract the device characteristics through the analysis of DC, AC and high frequency regimes, as shown in this paper. This work demonstrates the optimal device with a gate length of 15 nm, InAlN/GaN heterostructure and field plate structure, making it superior to modern HEMTs when compared with otherwise equivalent devices. This improves the ability to bear the burden of the current density passes in the channel. We have demonstrated an excellent current density, as high as 2.05 A/mm, a peak extrinsic transconductance of 590 mS/mm at VDS=2 V, and cutting frequency cutoffs of 638 GHz in the first HEMT and 463 GHz for Field plate HEMT., maximum frequency of 1.7 THz, maximum efficiency of 73%, maximum breakdown voltage of 400 V, DIBL=33.52 mV/V and an ON/OFF current density ratio higher than 1 x 1010. These values were determined through the simulation by deriving genetic and Monte Carlo algorithms that optimize the design and the future of this technology.

Keywords : HEMT, Silvaco, field plate, genetic algorithm, quantum
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