Device considerations and characterizations of pre and post fabricated GaAs based pHEMTs using multilayer 3D MMIC technology

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Abstract

This study focuses on the characterization of two 0.5 μm gate-length double heterojunction AlGaAs/InGaAs/GaAs pHEMTs using pre and post fabricated vertical oriented multilayer 3D monolithic microwave integrated (MMIC) circuit technology. The effects of the presence of 3D components above the active layer were accomplished by means of capacitance-voltage measurement, on-wafer DC and S-parameter measurements and two-tone intermodulation distortion measurement. The barrier height, donor concentration in the barrier layer, existing two-dimensional electron gas, output current, off and on state leakage, transconductance, cut-off frequency, small signal model parameters, gain, minimum noise figures and nonlinear distortion behavior reveals no significant performance degradation. Furthermore the fundamental device properties such as the depletion depth d, the sheet charge densities of the 2-DEG, n s, filed dependent mobility, μ, and the effective carrier velocity, v eff is not much affected due to multilayer processing. Less than 5% changes in magnitude of the device parameters are realized between the pre and post fabricated multilayer 3D MMIC technology. These effective comparisons of the both device are useful for future designs and optimizations of multilayer vertical stacked 3D MMICs.

Author keywords

3D MMICs AlGaAs/InGaAs/GaAs pHEMTs characterisation multilayer fabrication performance comparison

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