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Physics-based analytical modeling of AlGaN/GaN HEMT using gate field-plate technology for high-frequency applications

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The current trend is to fabricate (GaN) based devices due to the high energy gap, high breakdown field, and saturation velocity of gallium nitride for high-power amplifiers and high-frequency applications. This paper presents a newly developed compact model for input- output gate field-plated (FP) HEMT based on AlGaN/GaN heterojonction taking into account the effects of spontaneous and piezoelectric polarizations on sheet carrier concentration.
The proposed device incorporates a spacer layer of AlN to counter the decrease in mobility due to increasing 2-DEG (Two-Dimensional Electron Gas). Results showed that optimized FP design allows to considerably decreasing an electric field peak near gate edge towards drain electrode which enhance the breakdown voltage and decrease the reverse leakage current of HEMT devices. The proposed model provides the complete set of analytical equations that relate the physical design parameters to the electrical characteristics of the proposed device for high frequency, high-voltage and high-power applications such as radar and wireless communication systems.

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