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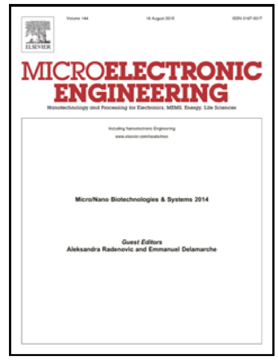


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# Nanofabrication of 80 nm asymmetric T shape gate for GaN HEMTs

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This paper tackles the issue of current colzlapse frequently seen in AlGaN/GaN based high electron mobility transistors, caused by peak electric field on the device surface around the gate edges, which are worsened when shrinking the gate length down to sub-100 nm for high frequency operation. To improve the device performance, a new configuration of T shape gates with asymmetric arms is proposed, based on our device simulation results. 3D grayscale electron beam lithography was developed to fabricate various shapes of the asymmetric T shape gates, indicating that such kind of gate configuration is technically feasible. The asymmetric T shape gates developed in this work to some extent can suppress the electric field on the gate edge efficiently as well as reduce the parasitic capacitance between the gate and the drain, leading to higher operation frequency. Applications of such a gate onto the GaN based HEMTs are hopefully to achieve high breakdown voltage for high frequency operation.

Keyword: Asymmetric T shape gates, 3D grayscale EBL, nanofabrication, GaN based HEMTs

## 1. Introduction

High electron mobility transistors (HEMTs) are extremely important in micro-terahertz wave communication and terahertz imaging systems. AlGaN/GaN based HEMTs are currently the mainstream in power devices[1-2], attracting increasing attempts to improve its high frequency performance to meet the requirement of the μ-wave and even THz wave applications. However, the research experience in the past decade has warned that it is not so straightforward as to raise the operation frequency simply by shrinking the gate length of a T shape gate (Figure 1a), as what has been succeeded in InP-based HEMTs[3]. The bottle-neck is the negative fixed charge accumulated at the gate-foot edge as well as the gate-head edge near the drain side on the device surface[4] and/or in the AlGaN and GaN layers[5], resulting in uneven distribution of electric field in the AlGaN/GaN heterojunction. These peak electric fields should be responsible for the current collapse[6] when the gate bias (Vg) is