

# Gan qing chu zhi piao.

- - Saya Chang

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**High-performance normally off p-GaN gate high-electron-mobility transistor with  $\text{In}_{0.15}\text{Al}_{0.85}\text{N}$  barrier layer design**

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**Abstract**  
This paper proposes a novel normally off p-GaN gate InAlN/GaN HEMT to replace p-GaN gate GaN/GaN HEMT for improving the device stability, reducing operation current, reducing the on-state resistance, improving the cut-off frequency and decreasing the self-heating effect. Due to the higher two-dimensional electron gas induced by the polarization, the on-state resistance for p-GaN gate InAlN HEMT can be lowered by 25% while the on-state current can be enhanced by 105% comparing with the common p-GaN gate GaN/GaN HEMT at  $V_{\text{GS}} = 5\text{ V}$ . The cut-off frequency of InAlN HEMT is 11.2 GHz, which is 50% higher than that of GaN HEMT. While the low breakdown voltage (BV) of InAlN HEMT restricts the device performance and power application. The thickness and polarity ratio of the passivation layer are found to influence the BV of the device significantly, due to the alteration of peak electric field in the drain-side gate edge, leading to a more uniform distribution of electric field in the channel. A proposed structure with TiO<sub>2</sub> passivation layer exhibits a breakdown of 105 V, showing 27% increase in breakdown voltage compared to the TiO<sub>2</sub> passivation layer GaN HEMT. These simulation results revealed that the p-GaN gate InAlN/GaN HEMT is a reliable candidate in power application.

**Keywords** GaN HEMT · p-GaN gate · InAlN · Passivation

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