

(54) Title of the invention : N-Polar AlGaIn/GaN High Electron Mobility Transistor (HEMT) using AlN Cap Layers and HfO2 Dielectrics with enhanced DC and RF performance

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(57) Abstract :
The present invention relates to a novel AlGaIn/GaN high electron mobility transistor (HEMT) (100) on a sapphire substrate (S) with a gate length of 10 nm, utilizing HfO2 gate layer (G) for passivation. The device (100) incorporates a 2 nm AlN cap layer (C2) improve 2DEG confinement and enhance thermal stability and surface passivation. The high-k (dielectric constant) HfO2 gate dielectric (G) reduce gate leakage current. The device (100) shows the maximum drain current of 1.13 mA/μm for VGS = 1 V and a peak transconductance of 0.66 mS/μm at VDS = 5 V. It also exhibits a high ION/IOFF ratio of 5.24 × 10⁸ and gate leakage current less than 16 pA/μm. The proposed device structure (100) shows the maximum cut-off frequency 209 GHz at VDS = 1 V. This finding demonstrates the potential of the proposed HEMT structure (100) for high-power and high-frequency applications, paving the way for advancements in next-generation electronic devices. [figure 1]

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