Simulation and Analysis of Gan High Electron Mobility Transistor (HEMT) to investigate the impact of back barrier on electrical Characteristics of device

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Aluminium Gallium Nitride/Gallium Nitride High Electron Mobility Transistor (HEMT) is a suitable candidate for high-power, high-speed and high- temperature applications due to AlGaN/GaN hetero-structure and the superior properties of wide band gap GaN-based materials i.e. high two-dimensional electron gas (2-DEG) density, high breakdown field, and high saturation velocity. However, due to the low height of the GaN buffer layer and as a result inadequate confinement in the channel, the transfer characteristics are severely weakened in these device. In order to overcome this problem, HEMT transistors was first reviewed in thesis, and then various HEMT structures, component modeling, carrier transport models, and boundary conditions were discussed. Considering the new structure of the GaN-based HEMT using the back barrier layer, the impact on device performance for AlGaN/GaN HEMT with varied dielectrics as surface passivation has been analysed using ATLAS device simulator. Compared to the conventional HEMT structure, the HEMT with barrier layer significantly improve electron confinement, which allows proper and safe operation against short channel effects. Therefore, the structure was investigated with various dielectric materials, SiO2, Si3N4, Al2O3 and TiO2 as a surface passivation layer, and three continuous scenarios were designed to achieve the best surface passivation method. The simulation results show that the drain current of the structure increases about 5% relative to the base structure by using oxide change and doping change, and also taking into account different work functions.

Keywords : Keywords: HEMT, GaN back barrier layer, AlGaN/GaN hetrostructure, ATLAS device simulator.

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