

Investigation into the Homoepitaxy of AlGa_N/Ga_N Heterostructure via Molecular Beam Epitaxy

Authors : Jiajia Yao, Guanlin Wu, Fang Liu, Junshuai Xue, Yue Hao

Abstract : As the production process of self-standing Ga_N substrates evolves, the commercialization of low dislocation density, large-scale, semi-insulating self-standing Ga_N substrates is gradually becoming a reality. This advancement has given rise to increased interest in Ga_N materials' homoepitaxial technology. However, at the homoepitaxial interface, there are considerable concentrations of impurity elements, including C, Si, and O, which generate parasitic leakage channels at the re-growth junction. This phenomenon results in leaked HEMTs that prove difficult to switch off, rendering them effectively non-functional. The emergence of leakage channels can also degrade the high-frequency properties and lower the power devices' breakdown voltage. In this study, the uniform epitaxy of AlGa_N/Ga_N heterojunction with high electron mobility was accomplished through the surface treatment of the Ga_N substrates prior to growth and the design of the AlN isolation layer structure. By employing a procedure combining gallium atom in-situ cleaning and plasma nitridation, the C and O impurity concentrations at the homoepitaxial interface were diminished to the scale of 10^{17} cm⁻³. Additionally, the 1.5 nm nitrogen-rich AlN isolation layer successfully prevented the diffusion of Si impurities into the Ga_N channel layer. The result was an AlGa_N/Ga_N heterojunction with an electron mobility of 1552 cm²/Vs and an electron density of 1.1×10^{13} cm⁻² at room temperature, obtained on a Fe-doped semi-insulating Ga_N substrate.

Keywords : MBE, AlGa_N/Ga_N, homogeneous epitaxy, HEMT

Conference Title : ICNS 2024 : International Conference on Nitride Semiconductors

Conference Location : Paris, France

Conference Dates : May 16-17, 2024