Reproducible and Highly Uniform Growth of GaN by MOCVD and MBE

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The high breakdown voltage and good thermal conductivity of the AlGaN/GaN material system enable linear, high power and survivable, low noise solid-state amplifiers with good operating efficiencies. At the present time, device performance is limited primarily by materials issues, i.e. variability in the quality of the substrate and the epitaxial HEMT structure. The reproducibility of high quality epitaxial materials is key to system implementation of this promising technology.

At Northrop Grumman, we have demonstrated 2" - 3" epitaxial films on semi-insulating SiC substrates with < 3% variability in critical film properties. This work entailed extensive study of the MBE and MOCVD growth processes and the relative importance of each variable, as well as the employment of techniques to control process parameters sufficiently for excellent film uniformity. Figure 1 illustrated our increasing control of the MBE grown epitaxial HEMT material as we have identified and improved the key growth variables.

We will discuss our growth capabilities, methods used to ensure reproducibility and uniformity, methods of mitigating critical material issues, and the relationships between material properties and device performance issues.

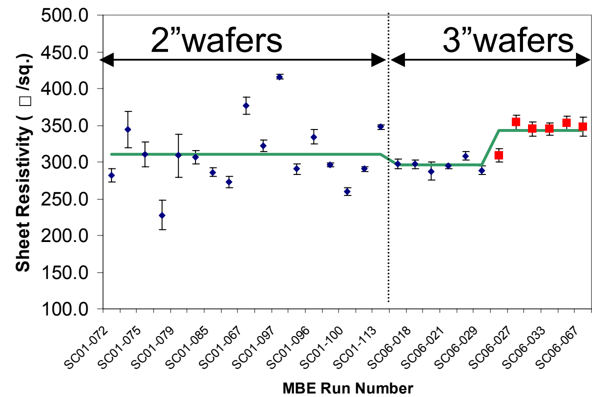

Figure 1. Average sheet resistance trend chart for MBE grown, 2” and 3” GaN HEMT epitaxial layers grown on semi-insulating SiC substrates. Within wafer variability is indicated by the error bars. Nominal within wafer variability achieved is less than 3% over a 3” wafer. We have steadily increased the wafer uniformity and reproducibility by identifying and optimizing the critical growth parameters.