Emerging Growth Opportunities for GaN Using Molecular Beam Epitaxy (MBE): From Research to Production

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Gallium Nitride (GaN) is a wide-bandgap semiconductor with exceptional properties, making it an ideal material for the new generation of optoelectronic and electronic devices such as UV LEDs, micro-LEDs, and RF components [1]. Molecular Beam Epitaxy (MBE) has proven to be an effective method for growing high-quality III-Nitride epilayers [2,3] due to its precise control over layer thickness, composition, purity and low growth temperature. This abstract explores the emerging growth opportunities for Nitride MBE production Machines, with a particular focus on the competitive advantages it offers in the development of next-generation of devices.

We highlight the Riber MBE 49 Nitride Production system (compatible with 1x200 mm and 3x4'' wafers), a fully automated hybrid production platform that is compatible with both ammonia and nitrogen plasma sources [4]. This system facilitates the production of high-quality GaN based layers with exceptional purity, crystal quality and uniformity. Optimizing the new generation of MBE production machines for Nitride applications permit the growth from research to large-scale production, supporting applications in optoelectronics and electronics fields.

Key results from the MBE 49-GaN system demonstrate the potential of this technology. Specifically, we report the dedicated MBE component developed for nitrides production machines, the layer thickness and composition uniformity $\leq \pm 2\%$ (with capabilities to reach uniformity $\leq \pm 1\%$) on 200 mm wafers. Additionally, high-purity GaN films with excellent crystal quality were confirmed through a combination of Secondary Ion Mass Spectrometry (SIMS), X-ray Diffraction (XRD), and Photoluminescence (PL) measurements.

These results confirm the system's ability to produce highly uniform, GaN based layers suitable for advanced applications.

The MBE 49-GaN system can also play a key role in the production of high-quality GaN/AlN based layers on silicon substrates [2], offering improved breakdown voltages, and reduced the RF losses. This makes the MBE 49-GaN system an optimal solution for high-volume production of next-generation GaN-based devices, driving the future of optoelectronic and electronic technologies.

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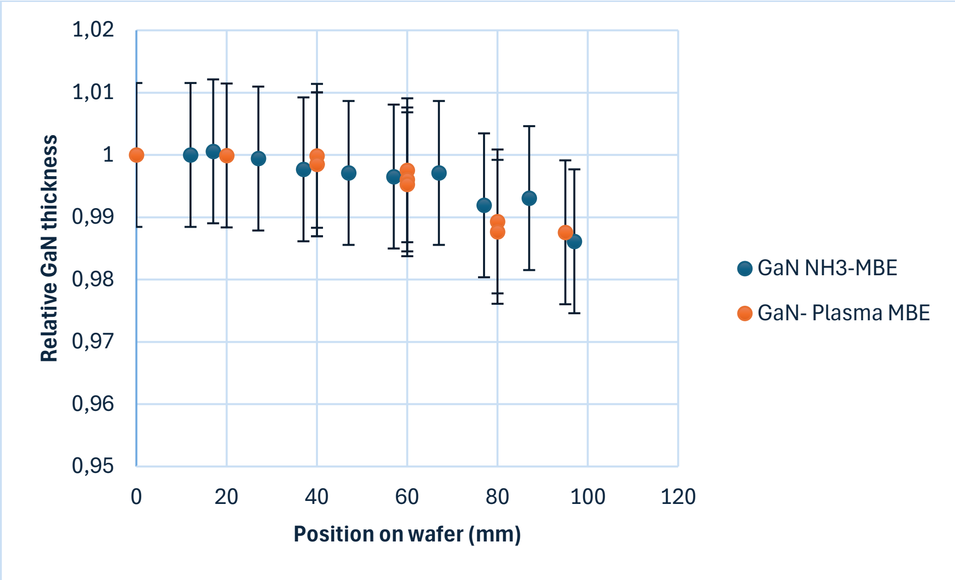

Figure 1. Uniformity of GaN thickness grown by plasma and NH_3 assisted MBE on a 200 mm Si wafer

Figure 2. 200mm GaN grown by MBE

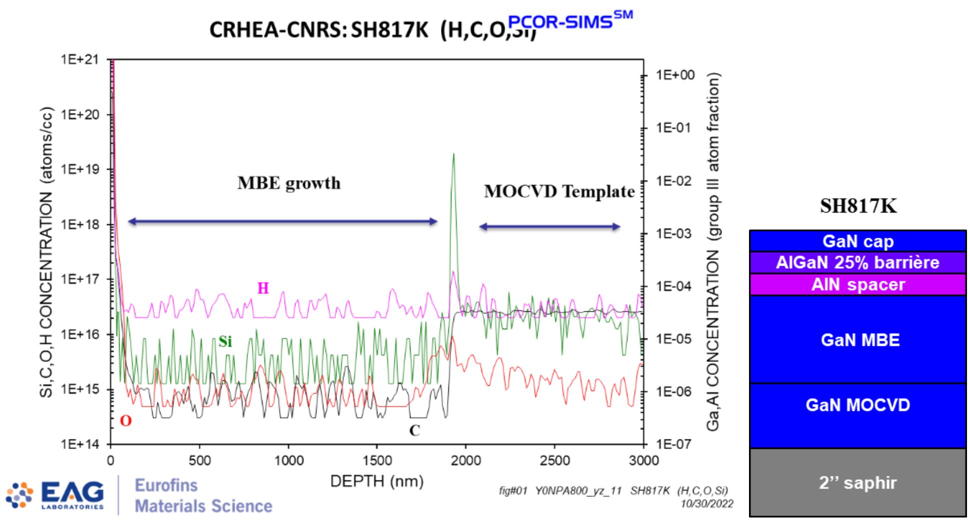

Figure 3. SIMS measurement of a HEMT structure grown by MBE on a GaN template grown by MOCVD