Contribution ID: **86** Type: **Oral**

A novel approach for the precise control of growth kinetics in GaN(0001) epilayers

Tuesday, November 5, 2024 5:30 PM (15 minutes)

Gallium nitride (**GaN**) is a highly effective semiconductor for a wide range of applications, including light-emitting diodes (LEDs) and laser diodes (LDs) *[1]*. However, the thermal, optical, and electrical properties of GaN vary significantly depending on the deposition parameters employed. Temperature control at each stage of deposition, such as steady state, accumulation of Ga monolayers, formation of Ga droplets, consumption of Ga droplets, crystallization of residual Ga monolayers, and restoration of steady state, is particularly important. Here, we demonstrate the advantages of our approach, which allows us to **monitor the growth kinetics** of the GaN layer and accurately distinguish between the accumulation of metallic Ga and its crystallization into GaN during molecular beam epitaxy (MBE). We present a novel method for **measuring nitrogen plasma** flux based on the analysis of signal variations recorded by a pyrometer. Consecutive metallic gallium deposition and GaN crystallization on GaN (0001) substrates were performed using different nitrogen plasma fluxes. The data demonstrate two distinct **linear behaviors of plasma flux** in relation to the plasma generation parameters: inert nitrogen gas flux and RF power. This technique circumvents the need for additional external equipment like RHEED or complex optical spectrometers, making it adaptable for both MBE and Metal-Organic Chemical Vapour Deposition (MOCVD) systems.

All the authors acknowledge funds from the *project ANTHEM 2022-NAZ-0488.*

1. S. Sanguinetti, S.Bietti, N.Koguchi, Droplet Epitaxy of Nanostructures, Molecular Beam Epitaxy, Elsevier, 2018, Pages 293-314.

Type of presence

Presence online

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Session Classification: Workshop on Sustainable Materials and Technologies

Track Classification: Workshop on Sustainable Materials and Technologies