EpiTwin TT – in-situ sensor for multi-wafer multi-ring MOCVD application

EpiTwin TT is the twin brother of LayTec's EpiTT sensor and has two optical heads for measurements at two independent positions. This sensor system is especially designed for application in AIXTRON Close Coupled Showerhead® (CCS) MOCVD reactors in GaN LED production with 19x2" or 30x2" (CRIUS) wafer configuration.

EpiTwin TT provides a complete control of every wafer in multiple-wafer configurations as well as homogeneity checks between inner and outer rings. It monitors growth rate and emissivity corrected temperature based on the combination of emissivity corrected pyrometry and reflectance measurements at two wavelengths.

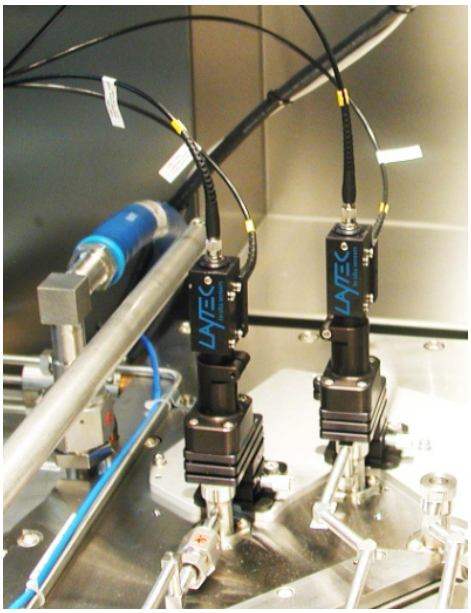

Fig. 1: EpiTwin TT set-up attached to AIXTRON CCS® CRIUS multiple-wafer ring MOCVD reactor.

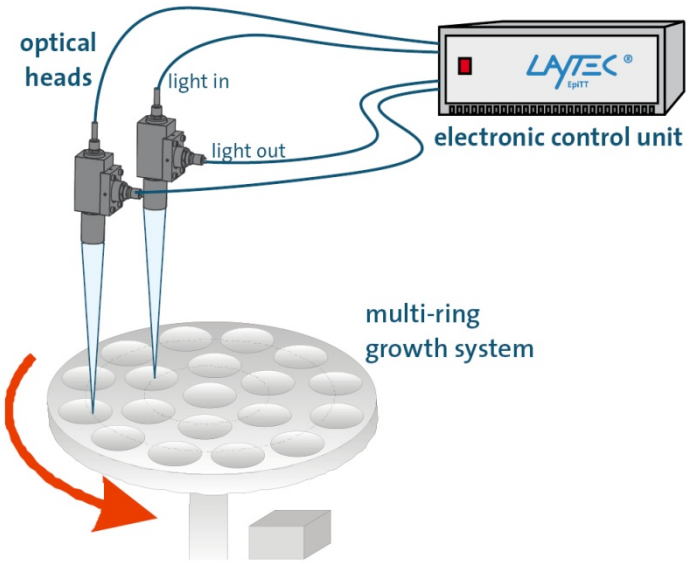

Fig. 2: EpiTwin TT system features a double-optical head and monitors reflectance and wafer temperature of every single wafer in multiple-wafer-ring configuration.

In multiple-wafer-ring deposition systems perfect temperature homogeneity of the wafer rings is necessary to ensure high yield and good wafer-to-wafer and run-to-run reproducibility.

Fig. 3 shows the data for a non-ideal GaN buffer layer growth run. During heating up, the **EpiTwin TT** data already shows that the outer ring is temporary hotter than the inner ring (overshoot at 750 s, +16 K). When the temperature stabilizes, the outer ring settles at a lower temperature than the inner ring (t>1000 s, difference of -1 K). During the nucleation layer phase typically grown at low temperatures the outer ring is colder than the inner ring. The initial difference (undershooting) is -10 K and settles at -4 K.

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The reflectance by the end of the nucleation phase (t=1800 s) is the same for both wafers, suggesting a similar layer thickness. However, different layer morphologies develop while growing the thick GaN buffer layer: the blue reflectance curve (from inner ring) shows a good GaN growth (no damping of the oscillations) while the red curve (outer ring) is damping due to surface roughness effects on the reflectance signal.

As the temperature comparison between inner and outer ring (details in Fig. 4) shows, the different dynamic behavior of the heating and the difference in temperature during the nucleation layer growth seems to be the main reason of the different GaN buffer growth later. The temperature difference between the inner and outer ring is larger at low temperatures (450-550°C). At high temperatures, however, a ring-to-ring temperature difference of 5 K is observed after settling.

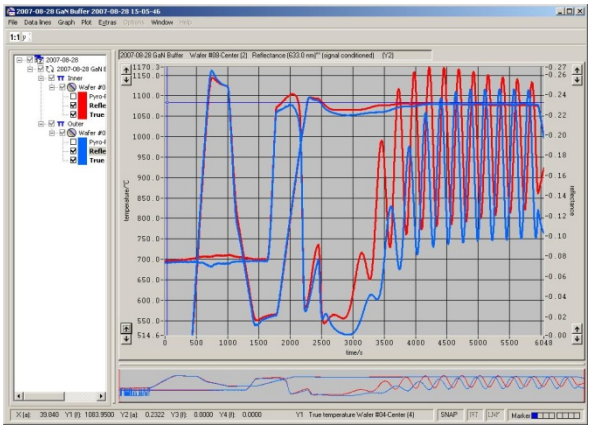

Fig. 3: Comparison of reflectance and temperature data gained on the inner ring (blue curves) and on the outer ring (red curves).

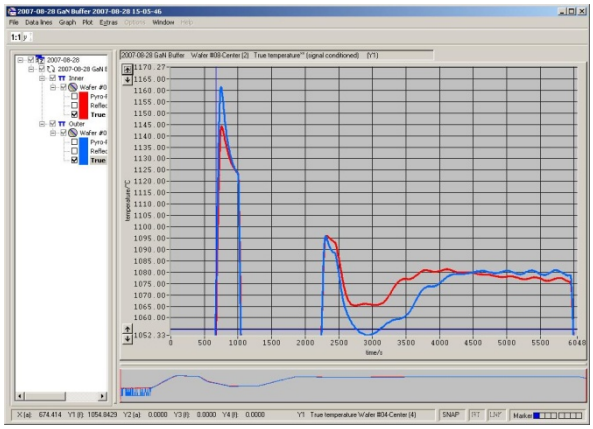

Fig. 4: Temperature data on inner (blue) and outer ring (red) as measured during a typical GaN buffer layer growth.

This data was measured in a reactor that has not been optimized yet. The example shows how important a perfect temperature match and a similar heating dynamics between inner and outer ring actually is (throughout the whole LED process!) for achieving high yield GaN LED production. **EpiTwin TT** data is seamlessly integrated into the current **EpiNet 1.10** software. The clearly structured navigation tools offer easy access to the data of both rings. Ring-to-ring comparison is as easy as wafer-to-wafer comparison. Specially designed eutectic wafers are delivered additionally for absolute temperature calibration.

On-site upgrades for existing **EpiTTs** on 19x2" or CRIUS MOCVD systems are possible as well. Even **EpiTriple TT systems (measuring at three wafer rings simultaneously)** are available from LayTec now. We also offer **EpiCurve®Twin TT**! This sensor is a combination of LayTec's **EpiCurve® and EpiTwin TT** sensors. It is the only in-situ tool that combines wafer bowing measurements with reflectance and emissivity-corrected pyrometry at two different measurement positions simultaneously!