In-situ wafer bow measurements in multi-pocket satellite configuration

While in-situ reflectance and temperature on a multi-pocket satellite susceptor can be measured very accurately, in-situ curvature monitoring is more tricky because it is rather challenging to find the wafer center. The new release of our control and analysis software EpiNet 2017 provides a solution for this problem. Fig. 1 shows the susceptor layout for a GaN/Sapphire run performed at Ferdinand-Braun-Institute (Berlin, Germany): Pocket #8 was loaded with a single 2" reference wafer, Pockets #5 and #6 contain three 2" wafers each, Pockets #1–4, 7 have dummy wafers.

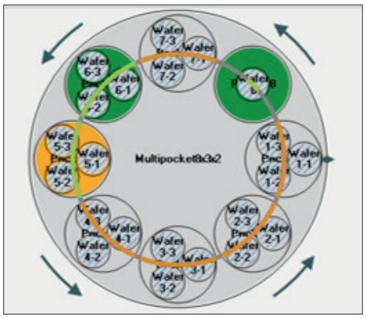

Fig. 1: Configuration panel of EpiNet 2017 showing the test run configuration: Pocket 5 - 3x2", Pocket 6 - 3x2", Pocket 8 - 1x2" reference wafer, all other - dummy wafers.

In Fig. 2, the wafer bow signals of the pockets loaded with epi wafers are compared. The values of the multi-pockets comply nicely with the those of the single-pocket. Analysis functions for wafer bow like curve slope (marked by a red line) work well both on single and multi-pocket. Besides, the signal-to-noise ratio (SNR) of the measurements on multi-pockets (shown here without filtering) stays within spec like that of the single wafer pocket.

To learn about further new features of EpiNet 2017, please visit laytec.de/epinet.

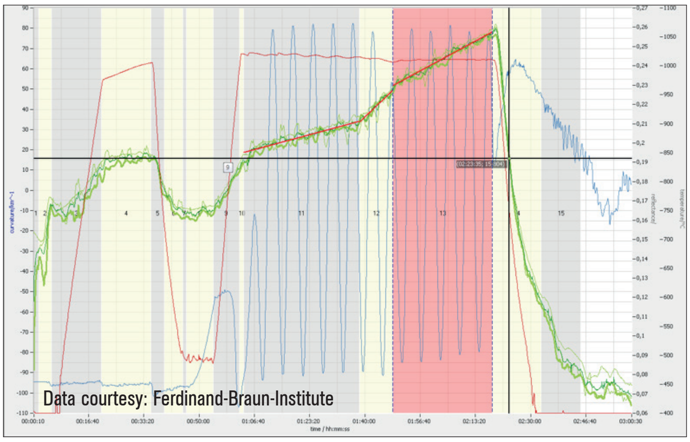

Fig. 2: In-situ measurements of GaN/Sapphire run (standard buffer growth on Sapphire as used for LEDs). Green transients - curvature signals, red - temperature, blue - reflectance. The curvature signals of the three loaded pockets (as described in Fig. 1) are in good compliance. The signal-to-noise ratio stays within spec also on multipocket satellites.

Optimizing quantum cascade laser (QCL) epitaxy with EpiCurve® TT

New in-situ results by Dr. Christine Wang and colleagues at the MIT Lincoln Laboratory (USA) have been presented in a recent paper [1]. The team worked on improving the MOCVD growth of InP-based QCLs in a Veeco D-125 multi-wafer (3x2”) reactor. Dr. Wang reported two major findings:

(1) The growth of high-performance QCL structures requires the deposition of a complex sequence of coupled quantum wells (AlInAs, GaInAs). During this process, the cumulative Indium surface segregation has to be carefully compensated in the growth recipe to keep the targeted lattice matched throughout the full QCL structure.

(2) Even under optimized growth conditions, a certain interface-grading is unavoidable, especially at the GaInAs-to-AlInAs interfaces. However, optimum QCL performance can be achieved by taking into account these interface grading effects in the calculations of the QCL target structure.

EpiCurve® TT was the key to these findings. Fig. 3 shows in-situ reflectance at 405 nm and curvature of the two decisive MQW runs. Reflectance oscillations correspond to each barrier and well layer and each layer is easily resolved. In Fig. 3b, the high-resolution wafer bow sensing verified the compressive strain accumulation at the AlInAs-to-GaInAs interface. After recipe optimization, the 450 nm reflectance could be used as a characteristic finger-print of the formation of every single graded interface among the hundreds constituting a single QCL layers. Learn more about EpiCurve® TT at laytec.de/epicurve!

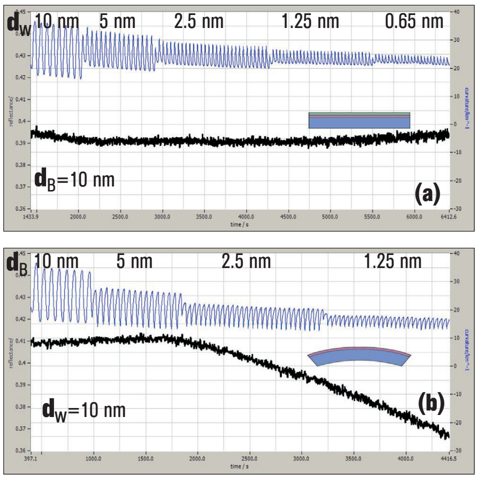

Fig. 3: In-situ measurements of AlInAs/GaInAs MQWs: reflectance at 450 nm (blue) and wafer curvature (black):

(a) Varying GaInAs well layer thickness d_W with constant 10 nm AlInAs barrier layer thickness d_B

(b) Varying AlInAs barrier layer thickness d_B with constant GaInAs 10 nm well layer thickness d_W

[1] Wang C.A. et al., Journal of Crystal Growth (2016)

You can meet us at the following workshops, conferences and trade fairs:

7–8 March 2017 | CS International | Brussels, Belgium

14–16 March 2017 | SEMICON China | Shanghai, China | LayTec talk: GaAs and GaN based device optimization by advanced epitaxial growth analysis

14–18 May 2017 | CS Week 2017 | Berlin, Germany