# LayTec's 21st in-situ seminar at ICMOVPE XVIII

More than 80 researchers and engineers took part at LayTec's in-situ seminar last week. They discussed the latest research results and learned about new in-situ metrology developments. Dan Koleske of Sandia National Labs (USA) presented in-situ results of AlN/sapphire growth measured by EpiCurve®TT at his Taiyo Nippon Sanso SR4000 reactor [1]. The talk of Gary Tompa of Structured Materials Industries (SMI, USA) focused on integration and utiliziation of EpiTT in SMI's $Ga_2O_3$ MOCVD system [1]. Hilde Hardtdegen (Research Center Juelich, Germany) reported on finding narrow growth temperature windows for novel $Ge_1Sb_2Te_4$ 2D materials by combining reflectance and temperature sensing of EpiR TT at her AIX 200 reactor [1].

Finally, Oliver Schulz of LayTec gave an overview on latest modular adaptations of LayTec's new Gen3 product lines to AIX Crius, AIX 6x2" and Veeco K700 reactors [download the talk]. Following the tradition, the second half of the seminar was devoted to in-depth discussions with and between our customers.

[1] For a PDF copy of this talk please contact info@laytec.de.

# Analysis of quaternary films at the nanometer scale with EpiNet 2016

In our newsletters in April 2016 and June 2015 we reported on XRD gauged nk database improvements for InGaAsP and InGaAlAs on InP and for ternary/quaternary materials on GaAs. The next release of LayTec's control and analysis software EpiNet 2016 (scheduled for Q4/2016) will offer completely new analysis features for our customers interested in high-accuracy statistical process control (SPC) of related device growth processes.

Fig. 1 gives an example: the thickness of very thin InGaAsP layers in a device stack grown in an AIXTRON Planetary Reactor® on InP(001) is determined by a well selected set of automated analysis operations. First, several InP layers are utilized for permanent in-situ high-accuracy re-calibration of all reflectance channels (yellow lines) in long lasting epi runs. Second, the lattice matching of the quaternary layers is verified by wafer bow analysis (not shown). Third, the composition of the quaternary material is determined at the thick InGaAsP layer in step #14. And finally, based on this information, the thickness of the thin InGaAsP layers in steps #2, #6 and #10 is accurately measured by double-wavelength thickness analysis.

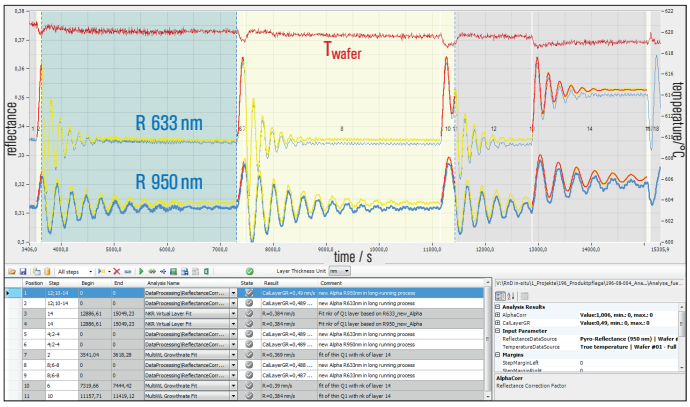


**Fig. 1:** Screenshot of the EpiNet 2016: data analysis of an InGaAsP/InP device structure on InP(001): the thickness of the three very thin InGaAsP layers in steps 2, 6, 10 is: 28.5 nm, 48.7 nm and 100.3 nm respectively. The table in the lower part of the figure gives the sequence of analysis functions for routine and automated SPC of this device growth process. T=temperature, R=reflectance.

For better understanding of growth processes, LayTec offers related training courses for process engineers and quality managers. Learn more about in-situ solutions for InP and GaAs based materials at laytec.de/InP and laytec.de/GaAs.

# In-situ lattice match sensing with XRD resolution by EpiCurve®TT Gen3

At ICMOVPE XVIII, we presented the talk "MOCVD of InGaAsP/InP based device structures: full replacement of ex-situ process calibration by advanced in-situ metrology". This work is a result of a close collaboration between the team of Tony SpringThorpe at the National Research Council of Canada, Christoph Hums and co-workers at Fraunhofer HHI (Germany) and LayTec.

During lattice matched growth of InGaAs on InP in an AIXTRON Crius reactor, the high-resolution wafer bow sensing (EpiCurve®TT Gen3 with ARS module) reached a resolution of 0.2 $km^{-1}$! Two effects that contribute to the wafer bow were carefully separated: the lattice mismatch between layer and substrate as well as the vertical temperature gradient across the wafer resulting from temperature difference between wafer pocket and showerhead. In result, the lattice match of InGaAs to InP could be tuned in-situ with a ±50 ppm resolution – an accuracy that formerly could be achieved only by ex-situ X-ray diffraction (XRD). Please download the talk here.

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

7–12 Aug. 2016 | 18th International Conference on Crystal Growth and Epitaxy (ICCGE 2016) | Nagoya, Japan | Booth 21

16–19 Aug. 2016 | 14th National Conference on MOCVD | Yanji, Jilin, China

4–9 Sept. 2016 | 19th International Conference on Molecular Beam Epitaxy (MBE 2016) | Montpellier, France