Gen3: new features of the next in-situ generation

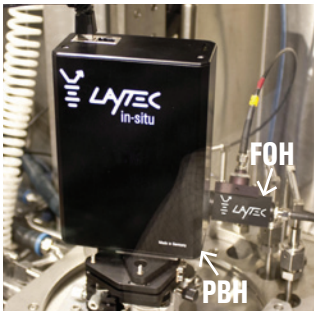

Fig. 1: EpiTT Gen3: the user can choose between a parallel beam head (PBH) and a fiber optical head (FOH - on a viewport behind PBH).

In October we announced the launch of LayTec's next generation in-situ metrology. Now, EpiTT Gen3 is available as the first representative of this product class!

What is new in Gen3? The backbone of the metrology's hardware and software is modularity. The new concept offers a much wider range of process specific customizations without compromising the robust and accurate performance our products are known for. Furthermore, the 24/7 operation is improved by separating data acquisition (based on ARM processors) from metrology control and analysis (based on MS Windows PC). In addition, Gen3 offers a significantly extended choice of process interfaces, e.g., SECS/GEM for communication with MES systems and Modbus for RIBER's latest Crystal XE software for MBE. Besides, the real-time and post-growth data analysis functionality has been further improved. Several completely new hardware components can be now combined with well proven working-horse modules that, of course, have been integrated into the new Gen3 platform, too. Find more at www.laytec.de/gen3.

UV LEDs: accurate temperature for pss and double-side polished sapphire

For UV LEDs, the emitted light usually exits the device structure through the sapphire substrate. Therefore, double-side polished (dsp) sapphire is frequently used. In addition, the front surface of the sapphire substrate can be modified by nano-patterned sapphire substrates (pss) for enhanced light extraction. Both substrate specifics often cause unrecognized artifacts in temperature sensing.

As an example, Fig. 2 shows a temperature step run with three different types of sapphire substrates: dsp, pss and ssp (single side polished). Conventional IR pyrometry (Fig. 2a) measures three different pocket temperatures for these wafer types. While the dsp sapphire substrate at 900°C gives the correct value, ssp is ~10 K and pss is ~25 K less than dsp. The level of the apparent (but not real) temperature reduction depends on temperature and on the details of back-side roughening, pss patterning and the reactor configuration. EpiTT Gen3, however, comes with new software algorithms that take these specific effects into account and deliver the same accurate pocket temperature for ssp, dsp and pss sapphire substrates (Fig. 2b).

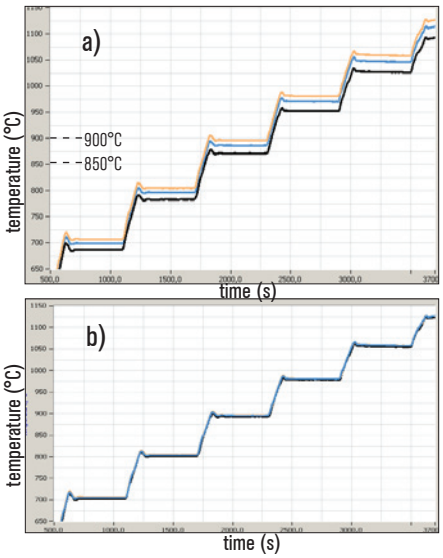

Fig. 2:
Temperature step run.
True Temperature at 950 nm:
blue - pocket W5 (ssp)
orange - pocket W6 (dsp)
black - pocket W8 (pss)
a) measured by a conventional emissivity corrected IR pyrometer
b) measured by EpiTT Gen3, which eliminates emissivity effects and straylight/defracting effects of the wafer's backside and/or of the pss frontside.

Overcoming the wafer-showerhead gap variation in UV LED epitaxy

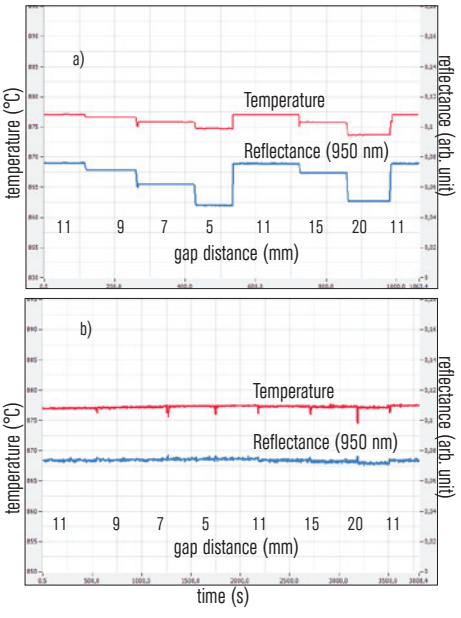

Fig. 3:
Reflectance (950 nm) and temperature data during variation of gap size:
a) FOH shows a reflectance drop of ~30% with respective temperature drop of several Kelvins depending on sample structure
b) PBH delivers a stable reflectance and temperature signal. At the standard gap distance (11 mm), both heads measure the same reflectance.
(Data measured with an AbsoluT thermal reference.)

For UV LED processes, EpiTT Gen3 can measure temperatures up to 1500°C. However, a further new Gen3 feature is also of importance - the possibility to choose between two types of metrology heads (see Fig. 1): fiber-optical heads (FOHs) and the new parallel-beam heads (PBHs). The latter is the tool of choice, e.g., for Close Coupled Showerhead (CCS) reactors, where the wafer-showerhead gap is adjusted to avoid pre-reactions and achieve high growth rates in UV LED processes. Fig. 3 shows that FOHs suffer from the off-focus situation, which has to be compensated by multiple-gap calibration, while PBHs deliver a very stable reflection and temperature signal despite the gap variation.

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

13–18 February 2016 | **SPIE Photonics West 2016** | San Francisco, CA, USA | Talk: "Process control of MOCVD growth for LEDs and other devices"

1–2 March 2016 | **CS International** | Brussels, Belgium | Talk: "Reliability and yield limiting variances in power electronic manufacturing - early detection by advanced in-situ monitoring"