Vertical cavity surface emitting lasers (VCSELs): LayTec's new EpiTT VCSEL UV

LayTec has added to its EpiTT VCSEL family the next in-situ metrology instrument: the new EpiTT VCSEL UV combines spectral sensing of UV-vis reflectance (300nm–800nm) with the well-known capabilities of EpiTT regarding wafer temperature sensing and high-accuracy multi-wavelength growth rate measurements.

Prof. Andrei Vescan and his team at RWTH Aachen are using this new metrology tool for accelerating their projects for GaN-based optoelectronic device growth. Fig. 1 shows the spectral in-situ reflectance signature of an AlGaN/GaN distributed Bragg reflector (DBR) as it is used in a novel type of GaN-based modulator devices combining epitaxial III-N bottom DBRs with dielectric top DBRs.

This project has been funded by BMBF (Next-Generation LED - 13N14223/13N14224).

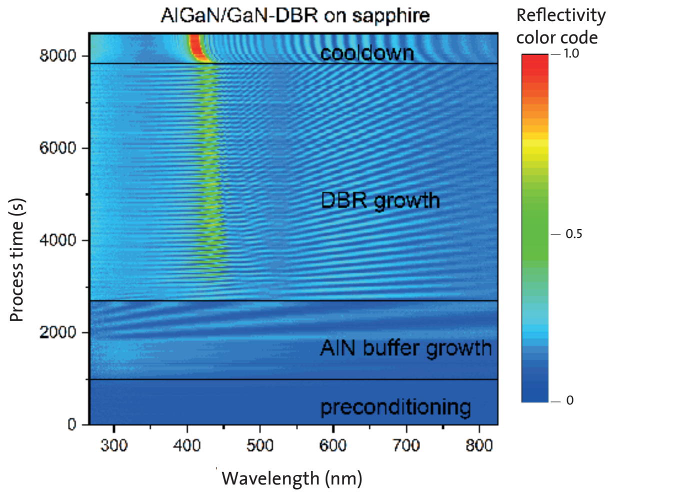

Fig. 1: Spectral reflectance signature of an AlGaN/GaN DBR during growth in Aix 200 RF/S reactor. The DBR stop-band is clearly seen at λ=420nm (growth) and 405nm after cooldown.

EpiTT VCSEL – improved in-situ prediction of VCSEL emission wavelength

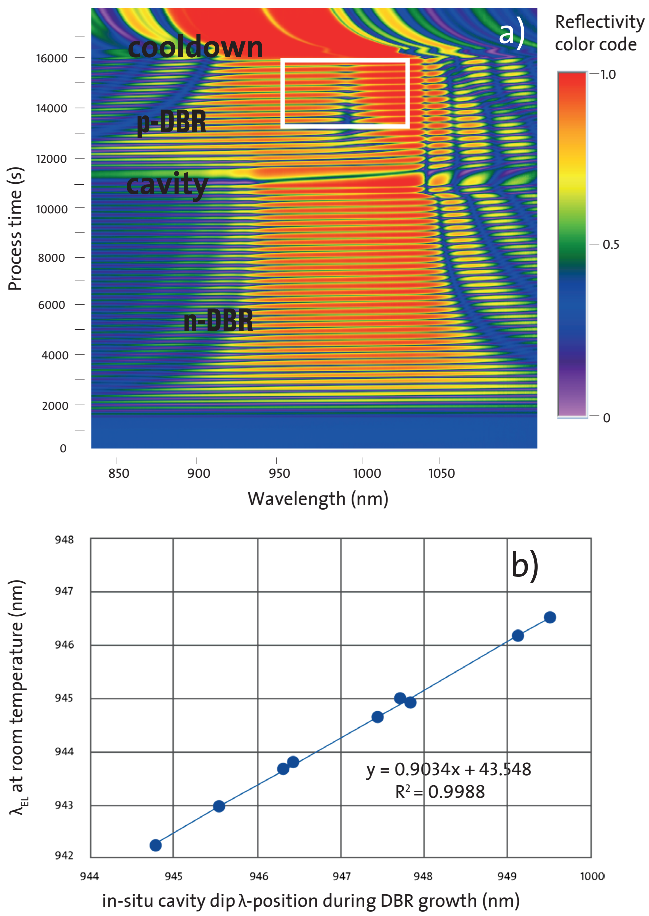

Fig. 2: 940nm VCSEL: a) reflectance color plot as measured during epitaxy. The white square marks the in-situ cavity dip region during p-DBR growth. b) correlation between the in-situ cavity dip position and the room-temperature electro-luminescence (EL) emission wavelength.

The target specifications for VCSEL emission wavelengths currently lie within the ±0.5nm accuracy range. Consequently, for yield prediction based on spectral in-situ sensing an even better wavelength accuracy is needed. LayTec has recently developed advanced algorithms for dynamic cavity dip analysis during p-DBR growth that take into account the specifics of wafer rotation in planetary reactors and apply advanced filtering and averaging procedures. The resulting ±0.2nm accuracy in in-situ measurement of high-temperature cavity dip positions during the final periods of the p-DBR allows for a highly precise prediction of the VCSEL emission wavelength.

Fig. 2a gives an example in-situ reflectance color plot with the cavity-dip clearly visible during p-DBR growth. Fig. 2b shows more results from this VCSEL run: R^2=0.999 correlation between the in-situ measured cavity dip position during the final 10 periods of the p-DBR and the emission wavelength as measured by electro-luminescence (EL) at room-temperature after the run. A deeper insight into the origin of the wavelength distribution can be gained by correlation of these high-accuracy cavity dip positions with wafer temperatures and satellite numbers.

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

05 February 2020 | **SPIE Photonics West** | CA, USA | LayTec talk:

Dr. Kolja Haberland on "Advances in in-situ metrology during epitaxy of UV-LEDs and related optical devices"

31 March – 01 April 2020 | **CS International** | Brussels, Belgium | LayTec talk:

Dr. Iris Claussen on "Advanced in-situ metrology for high-yield epitaxy of SiC/SiC, GaN/SiC and GaN/Si device structures"