III-Nitride growth – how to get device related real-time process quality signatures

Talk at ISGN-5 (Atlanta, May 2014) – here: selected slides on AlInN-DBRs

Stephanie Fritze\textsuperscript{1}, Christoph Berger\textsuperscript{2} and Marcello Binetti\textsuperscript{1}

\textsuperscript{1} LayTec AG, Berlin, Germany
\textsuperscript{2} Otto-von-Guericke University, Magdeburg, Germany
AllInN/GaN DBR: tight control needed ➔ in-situ metrology

- stop band of 45 pair AlInGaN/GaN DBR at RT
During growth: only the upper-most 8-10 layer pairs of the DBR are sensed by 405nm reflectance due to absorption.

The n,k data for simulation have been derived from E Sakalauskas1 et al., J. Phys. D, Appl. Phys. 43 (2010) 365102.
405nm reflectance indicates: small drift in DBR properties


Fit to $R_{405nm}$: 43.3nm AlInN

36.8nm GaN

--- Reflectivity @405nm
--- Reflectivity @950nm

Ideal DBR would give zero drift $R(405nm)$ signatures, but...
Wafer bow indicates: small GaN/AlInN mismatch

Very long process $\Rightarrow$ ceiling coating $\Rightarrow$ increasing GaN-surface temperature $\Rightarrow$ composition shift towards less In?

May 19th 2014  |  Optical in-situ signatures for III-Nitride device Epi
Conclusion

For high-yield MOCVD processes of III-Nitride based devices the contribution of industrial and academic research is:

→ Investigate and understand physics of III-N in-situ signatures
→ Establish solid correlation of metrology data: in-situ vs. ex-situ
→ Establish clear correlation: in-situ signatures vs. device performance
Knowledge is key

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