Optimization of InGaAs metamorphic buffer for laser diodes using EpiCurve® TT

Temperature characteristics of laser diodes (LDs) on GaAs substrate depend on the quality and the thermal resistance of InGaAs metamorphic buffer layer. At the Electronic Materials Symposium (July 2013, Japan), NTT Photonics Laboratories (NTT) presented a new method for optimization of the metamorphic buffer layer for free-standing quasi-InGaAs substrates.

Mr. Ryo Nakao from NTT uses LayTec's in-situ metrology system EpiCurve® TT to improve layer thickness and indium content in order to fabricate a thin InGaAs metamorphic buffer with low thermal resistance. The in-situ tool helps understand the MOVPE growth conditions and shows the changes in wafer curvature caused by residual strain during MOVPE growth.

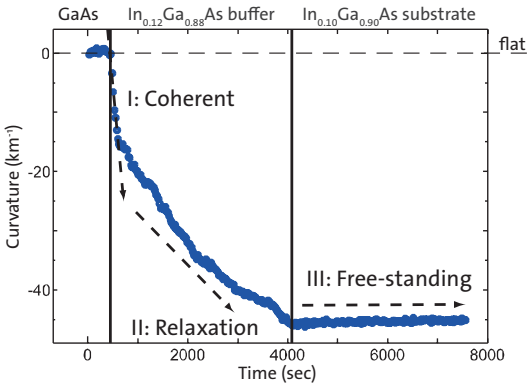

Fig. 1: In-situ curvature data of InGaAs buffer and quasi-InGaAs substrate on GaAs substrate.

Fig. 1 shows in-situ curvature data for a 1250 nm metamorphic InGaAs buffer layer and a quasi-InGaAs substrate layer. The growth can be separated into 3 parts: I - Coherent (pseudomorphic) growth of the buffer, II - Growth with relaxation, III - Free-standing (unstrained) growth. During relaxation, the in-plane lattice constant of the $In_{0.12}Ga_{0.88}As$ layer increases. After the buffer has reached 1250 nm, its lattice constant exactly matches the lattice constant of $In_{0.10}Ga_{0.90}As$. As a result, the wafer curvature does not change during the subsequent growth of $In_{0.10}Ga_{0.90}As$ layer. The authors call this final growth phase "free-standing" because the $In_{0.10}Ga_{0.90}As$ layer grows with its natural lattice constant and creates a quasi-substrate similar to an $In_{0.10}Ga_{0.90}As$ wafer for the later device growth.

Further experiments with the same indium content and different buffer thicknesses showed that if the relaxation is not sufficient (buffer thickness=1000 nm), the quasi-$In_{10}Ga_{90}As$ substrate growth is compressively strained. However, over-relaxation (1600 nm) results in a tensile strain.

The researchers plotted these changes to obtain a map of the correlation between thickness and curvature [1]. For a free-standing quasi-InGaAs substrate, they choose a buffer thickness with no further variation in curvature over time during $In_{0.10}Ga_{0.90}As$ growth.

This work shows that in-situ curvature measurements are a decisive part of an innovative technology that is developed to improve characteristics of LDs. Find more at www.laytec.de/epicurve

[1]: Ryo Nakao *et.al.* EMS-32 proceedings (2013)

In-situ seminar at ICNS 2013: customers show latest in-situ data of nitride growth

On August 25, LayTec's 18th international in-situ seminar took place in conjunction with the ICNS in Washington, USA. We were pround to welcome international experts who presented their latest in-situ results of nitride growth monitoring:

- Alois Krost (Otto-von-Guericke University Magdeburg, Germany): Growth and characterization of GaN on Silicon wafers
- Yvon Cordier (CNRS-CRHEA, France): Assessment of strain in GaN films by using in-situ and ex-situ characterization techniques
- Fabrice Oehler (University of Cambridge, UK): Current challenges for in-situ monitoring of polar and semi-polar III-Nitrides

Neil Gerrard, managing director of LayTec UK Ltd, presented a newly developed method for pre-selecting patterned sapphire (PSS) wafers according to pre-bow and PSS uniformity. Our customers took the opportunity to check their PSS wafers on-site. LayTec's head of R&D Kolja Haberland had a talk about our new product developments. Oliver Schulz, the chief customer officer of LayTec, explained the new concept of LayTec Premium Care. To download the talks on our website, please ask for the password via info@laytec.de.

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

19 – 20 September 2013 | Berlin WideBaSe Conference on Technology and Applications of Nitride Semiconductors | Berlin, Germany | www.berlin-widebase.de

30 September – 1 October 2013 | Deutscher MBE Workshop | Dresden, Germany | www.namlab.com (booth of our distributor EpiServe)