MICRONOVA
CENTRE FOR MICRO- AND NANOTECHNOLOGY
TKK – HELSINKI UNIVERSITY OF TECHNOLOGY

ULTRA-FAST MICROLASER MODULE FOR OPTICAL COMMUNICATIONS

NANOTECHNOLOGY GROUP

OPTOELECTRONICS LABORATORY

Low-cost lasers with short pulse duration and high repetition rate are urgently required to meet the constantly growing demands of high-speed data transmission in optical networks at the telecommunications wavelength of 1.5 µm. Such a laser can be realized with an erbium-doped waveguide laser which uses a semiconductor saturable absorber mirror (SESAM) as one cavity mirror.

SESAM is a structure of non-linear absorption, which is the property that enables the mode locking of lasers with SESAMs. SESAM consists of a Bragg mirror and an absorber structure fabricated on top of the mirror. In this project we aim to combine a high-reflectivity AlAs/GaAs Bragg mirror and an absorbing quantum well (QW) structure suitable for use at optical telecommunication wavelengths. Such a QW absorber can be realized by GaAs based dilute nitride materials.

RECENT RESULTS

The band gap – and therefore the operational wavelength – of GaAs based dilute nitride materials, GaAsN and InGaNAs, is strongly affected by the nitrogen content of the sample. This dependence can be seen in Figure 1. We have performed growth parameter optimisation for both these materials utilizing low-pressure metal-organic vapour phase epitaxial system in order to fabricate the ultra-fast SESAM component.

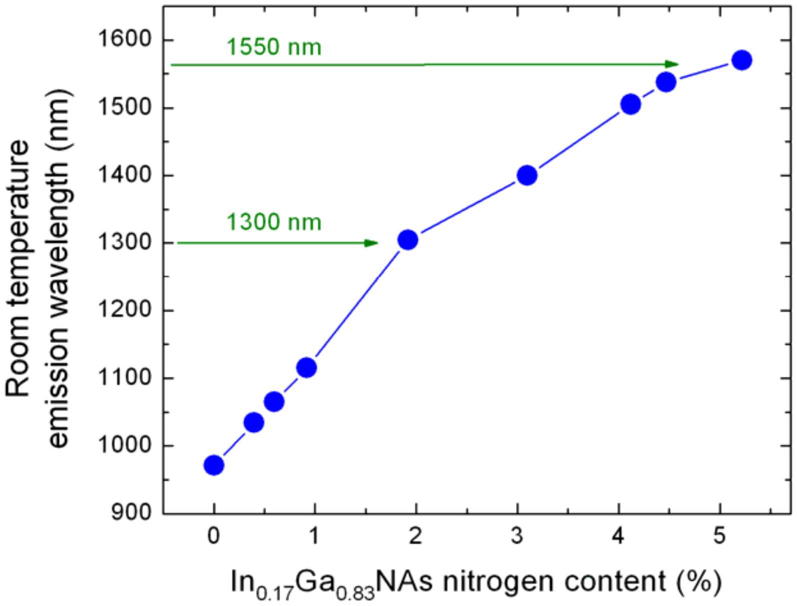

Figure 2: The room temperature emission wavelength as a function of the nitrogen content of the InGaNAs quantum well. With 17 % of indium, the optical telecommunication wavelengths 1300 nm and 1550 nm can be achieved with nitrogen contents of about 2 % and 5 %, respectively.

Recently, we also have developed techniques and models for real-time composition and crystalline quality determination from in-situ reflectance data. This has proven to be a crucial tool in both basic material research and complex component structure fabrication. An example of an in-situ reflectance curve measured during the growth of the absorbing QW structure of a SESAM component is shown in Figure 2. Growth regions of the quantum well stacks and GaAs spacer layers are denoted in the figure.

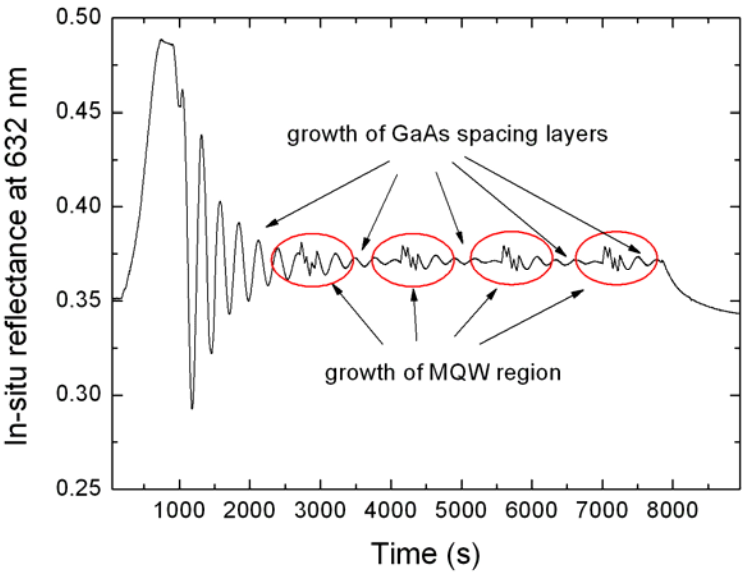

Figure 2: In-situ reflectance curve recorded during the MOVPE growth run of a SESAM absorber structure consisting of five stacks of four InGaNAs/GaAs quantum wells (only four stacks are visible in the figure).

Funding

Academy of Finland

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Recent Publications

1. O. Reentilä, M. Mattila, M. Sopanen, H. Lipsanen, *Nitrogen content of GaAsN quantum wells by in-situ monitoring during MOVPE growth*, to be published in Journal of Crystal growth

2. L. Knuuttila, O. Reentilä, M. Mattila, H. Lipsanen, *Comparison of Ge and GaAs Substrates for Metalorganic Vapor Phase Epitaxy of GaIn(N)As Quantum Wells*, Japanese Journal of Applied Physics **44**, pp. L1475-L1477 (2005)

3. O. Reentilä, M. Mattila, H. Lipsanen, S. Yliniemi, S. Honkanen, *Valolla vauhtia viestintään*, Prosessori, ES, November, pp. 27-28 (2004)