Fonctions Optiques pour les Technologies de l'informatiON
http://foton.cnrs.fr
Enssat
6, rue de Kerampont
CS 80518
22305 Lannion cedex
T. 02 96 46 91 41
F. 02 96 37 01 99
UMR 6082

Thesis Defense of Antoine CONGAR on next 2nd september.
You can communicate this information to colleagues, who may be interested.

Thesis Defense
Institut Foton – Photonics Systems team
Monday 2nd of september 2019, 2:00 pm (room 137C)

Spectral narrowing and intensity noise of coherent light sources based on gallium nitride laser diodes emitting in the blue range

Antoine CONGAR

Jury :

Isabelle SAGNES	*Director of research, C2N, CNRS*	Examinator
Jean-Yves DUBOZ	*Director of research, CRHEA , CNRS*	Examinator
Dmitri BOÏKO	*Expert Senior, CSEM, Neuchâtel*	Member
Raphael BUTTÉ	*Lecturer & Researcher, EPFL, Lausanne*	Member
Thierry GEORGES	*Engineer PhD, OXXIUS, Lannion*	Member
Monique THUAL	*Professor, Institut Foton, Rennes University*	Member
Stéphane TREBAOL	*Assistant Professor, Institut Foton, Rennes University*	PhD Manager
Pascal BESNARD	*Professor, Institut Foton, Univ Rennes*	PhD Supervisor

Abstract

Many applications require coherent visible light sources, in particular in the blue range. Solutions commercially available are mostly expensive and not compact. In this thesis we study the possibility of creating blue single-mode light source based on InGaN/GaN laser diode which could be a low-cost device, easily integrated into photonic systems. The first work is the study of relative intensity noise (RIN) of gallium nitride edge emitting laser diodes. The strong correlation between noise dynamics and spectral behavior impacted by mode clustering is highlighted. An analytical model is used to reproduce the experimental results. The second work is a study of blue/purple (400-450 nm) single- longitudinal-mode laser diode (LD). Spectral filtering is achieved using high order aperiodic Bragg grating. A novel approach involving standard lithography technique with a resolution close to the micron is proposed unlike state of the art works using high resolution e-beam lithography. Release of the resolution constraint paves the way for mass production of low-cost single-mode devices. Aperiodic grating, mostly used in the telecom range, is adapted to 420 nm using numerical modelling. First single-mode structures are fabricated at EPFL. Measurements of optically pumped devices prove the feasibility of the technique. The last contribution of this thesis, concerns the spectral narrowing of InGaN LD by means of external cavity. Feedback is provided by a specially designed 400 nm Bragg grating optically written on a single-mode fiber. Using that setup, we obtain single-frequency emission with more than 40 dB side-mode suppression ratio, about 50 mW optical power and less than 2.4 MHz linewidth. Results are encouraging in both approaches, monolithic and external feedback, and offer various possibilities in terms of applications.

***KEYWORDS** : Single-mode InGaN/GaN laser diodes ; aperiodic grating ; fiber Bragg grating ; intensity noise*