DS 6: Nanophotonics - Theory of Nanophotonic Devices II

Time: Monday 14:00–15:15 Location: GER 38

Topical Talk DS 6.1 Mon 14:00 GER 38

All-optical memory based on a two-mode laser diode — •Andreas Amann, Simon Osborne, and Stephen O'Brien — Tyndall National Institute, University College Cork, Ireland

We present a method for tailoring the spectrum of an optical resonator by the use of additional perturbative features. For a predefined mode spectrum, the position of the features are obtained by solving an associated inverse problem. We have employed this method to design a two-mode edge emitting Fabry-Perót laser diode with a primary mode spacing in the THz regime.

Under optical injection into one of the modes this two-mode laser shows experimentally a number of complex dynamical phenomena as the injection strength and the detuning of the injected mode are varied. In particular the observed bistability between a single-mode locked state and a two-mode lasing state allows us to realize an all-optical memory element, where the switching is realized via a modulation of either the strength or the detuning of the injected mode. We are able to accurately reproduce and understand the observed phenomena on the basis of a surprisingly simple rate equation model.

Topical Talk DS 6.2 Mon 14:30 GER 38

Novel Concepts of High Power Diode Lasers: High Brilliance and Wavelength Stabilization — •Vitaly Shchukin[1,2], Nikolai Ledentsov[1,2], and Dieter Bimberg[1] — [1]Technische Universitaet Berlin, Berlin, Germany — [2]Present address: VI Systems GmbH, Berlin, Germany

Novel concepts of high power diode lasers enable solving the problem existing since decades: poor beam quality and an unstable wavelength of lasing rapidly shifting upon current and temperature variations.

i) Photonic Band Crystal Laser provides a strong discrimination of a fundamental mode localized at an optical defect against the rest not localized modes, which enables a single mode lasing from an ultra-broad waveguide (WG), and thus high brilliance narrow beam operation.

ii) Tilted Cavity Laser contains a narrow cavity and a multilayer interference reflector (MIR). Different angular behavior of the cavity mode wavelength and MIR reflectance maximum provides wavelength-selective leakage loss from the cavity through the MIR and enables wavelength-stabilized operation. The theory predicts a possibility to reach zero and even negative thermal shift of the lasing wavelength.

iii) Tilted Wave Laser contains a narrow WG coupled with a broad WG. Light generated in the narrow WG leaks to the broad WG, propagates there as a tilted wave, is reflected back, and returns to the narrow WG. The phase matching conditions between the wave propagating along the narrow WG and the returned wave govern the wavelength-stabilized lasing, and the broad WG promotes an ultra-narrow beam.

Modeling and experimental proof-of-concepts will be presented.

DS 6.3 Mon 15:00 GER 38

Control of the Linear Polarization of Excitonic Emission from Group-III-nitride Quantum Dots — •Momme Winkelnkemper, Gerald Hönig, Andrei Schliwa, and Dieter Bimberg — Institut für Festkörperphysik, Technische Universität Berlin, Hardenbergstraße 36, 10623 Berlin, Germany

Control of the polarization of emission from single QDs is of major importance for applications, such as QD-based single-photon emitters for quantum cryptography. The properties of excitonic emission from bulk wurtzite group-III nitrides are governed by the valence band (VB) structure of these materials. A, B, and C excitons can be unambiguously identified analyzing the linear polarization of their emission in different detection geometries. Order and character of the VBs can be altered if the material is strained. Here, we show that a structural anisotropy of InGaN/GaN quantum dots (QDs) leads to a linear polarization of confined A- and B-type excitonic states in orthogonal directions. Moreover, we predict a similar polarization effect for GaN/AlN QDs and show that it is, in fact, evoked by an anisotropy of the strain field within the QDs. Using strain-dependent eight-band k.p theory we calculate the polarization of the optical transitions in either elongated QDs or QDs under externally applied stress. For both cases a pronounced linear polarization is found. By performing a quantitative study we show that the polarization of the ground state transition can be effectively controlled by externally applied uniaxial stresses.