HL 53.7 Di 16:30 TU P270

First experiments in epitaxial growing of carbon doped two-dimensional hole gases (2DHGs) in GaAs/AlGaAs heterostructures resulting in mobilities beyond 10^6cm^2/Vs — •Christian Gerl, Stefan Schmult, Hans Peter Tranitz, and Werner Wegscheider — Universität Regensburg, Institut für Experimentelle und Angewandte Physik, 93040 Regensburg

The almost perfect lattice match between Galliumarsenide (GaAs) and Aluminumarsenide (AlAs) yield some important developments in the heteroepitaxy within the last 30 years. Results are for example high electron mobility two-dimensional electron gases exceeding mobility values in the order of 10^7cm^2/Vs. High electron mobilities are essential for the fractional quantum hall effect. Even if the epitaxial growth of low-dimensional high mobility electron systems in GaAs/AlGaAs heterostructures is a state of the art technique today, the growth of similar holes systems is still a fundamental challenge. Beryllium, for instance, acts like an acceptor in (001) GaAs and AlGaAs, with the disadvantage of the segregation for the underlying growth conditions. Silicon, acting as the standard donor in the considered material system for many growth directions, can also yield hole doping, e.g. on (311) GaAs. Recently, the signature of the quantum hall effect in carbon-doped 2DHGs has been reported. We will present our results on C-doped high mobility 2DHGs in the heterosystem GaAs/$Al_{0.33}Ga_{0.67}As$. Optimization has led to hole mobilities up to 1.1×10^6cm^2/Vs at densities of 2.5×10^{11}cm^2 determined in low temperature magnetotransport measurements.

HL 54 Photonische Kristalle III

Zeit: Dienstag 15:00–16:30 Raum: TU P164

HL 54.1 Di 15:00 TU P164

Laser Direct Writing of three-dimensional Photonic Crystals in high-index of refraction chalcogenide glasses — •Sean Wong[1], Georg von Freymann[1], Geoffrey A. Ozin[1], Markus Deubel[2,3,4] und Martin Wegener[2,3,4] — [1]Materials Chemistry Research Group, Department of Chemistry, University of Toronto, M5S 3H6, Toronto, Canada — [2]Institut für Angewandte Physik, Universität Karlsruhe (TH), 76128 Karlsruhe — [3]Institut für Nanotechnologie, Forschungszentrum Karlsruhe, 76021 Karlsruhe — [4]CFN, Universität Karlsruhe (TH), 76128 Karlsruhe

We present a two-step method for the direct fabrication of high-index of refraction three-dimensional Photonic Crystals.

Direct laser writing [1] in arsenic-sulphur based thin films of chalcogenide glasses with high-intensity 120fs pulses induces a local chemical phase change via two-photon absorption to As_2S_3. The inscribed three-dimensional Photonic Crystals are subsequently etched out with a specially designed wet chemical etchant. In principle, the index of refraction of As_2S_3 ($n = 2.45$) is high enough to open a complete band gap in diamond-like crystal structures, e.g. the woodpile structure, although further optimization of the writing process is required to achieve this goal. As our approach does not require any subsequent inversion with high index material, it might prove as a new route for the direct fabrication of functional Photonic Crystals.

[1] M. Deubel et al., Nature Materials 3, 444 (2004)

HL 54.2 Di 15:15 TU P164

Focusing and negative group velocity in a planar array of dielectric rods — •Dan Davidov[1], Yair Neve-Oz[1], Yuval Saado[1], Michael Golosovsky[1], and Avri Frenkel[2] — [1]Racah Institute of Physics, Hebrew University of Jerusalem, 91904 Jerusalem, Israel — [2]ANAFA Electromagnetic Solutions Ltd, P.O.B. 5301, Kiriat Bialik 27000, Israel

We suggest 2D photonic crystals (PC) consisting of a periodical array of dielectric rods in which array of point defects form a superlattice. The defects are made from different dielectric rods with different sizes and different dielectric constants. The distance between the defects is such that they are electromagnetically coupled to form coupled cavity propagating mode, CCM . This results in a defect band inside the photonic bandgap. Simulations using ANSOFT software demonstrate, at frequencies corresponding to the defect band, an extremely low group velocity in finite size PC and a negative group velocity in the band structure of infinite size PC. The above results are based on simulations. As a first step towards implementation, we have constructed a 2D photonic band gap material consisting of dielectric rods designed to operate in the mm wave range. In particular, we made from it a concave mirror and showed that in the frequency range corresponding to photonic stopband this mirror allows wave focusing with the spot size of 0.35 lambda. In this case simulations and experiments completely agree, so we are confident that a negative group velocity both in the microwave and in the infrared range can be realized using the CCM idea presented here.

HL 54.3 Di 15:30 TU P164

GaN Photonische Kristall Membran Kavitäten — •Cedrik Meier[1,2], Kevin Hennessy[1], Elaine D. Haberer[1], Rajat Sharma[1], Kelly McGroddy[1], Steven P. DenBaars[1], Shuji Nakamura[1] und Evelyn L. Hu[1] — [1]Materials Department, University of California, Santa Barbara, CA 93106 — [2]Experimentalphysik, Universität Duisburg-Essen, D-47048 Duisburg

Photonische Kavitäten wie Mikrodisks, Mikropillars und Photonische Kristall-Kavitäten bieten die Möglickeit, Licht in definierte, wohldefinierte Moden einzuschließen. Durch Kopplung von aktiven Schichten (Q-Dots / Wells) an diese Moden kann die Emission verändert werden (Purcell-Effekt). Anwendungen sind etwa Lasing mit niedriger Schwelle oder in der Quanten-Kryptographie. Von allen o. a. photonischen Resonatoren bieten Defekte in photonischen Kristallen das kleinste Modenvolumen bei hohen Q-Faktoren. Um dies zu erreichen, stellen wir dünne Membranstrukturen mit einem 2D photonischen Kristall-Defekt her. In vertikaler Richtung sorgt der Unterschied im Brechungsindex zwischen GaN und der Umgebung für den photonischen Einschluss. Die Herstellung solcher Membranen in verschiedenen Materialien kann durch konventionelles selektives Ätzen erreicht werden. In GaN ist dies nicht möglich, da in diesem System keine konventionelle Nass-Ätze zur Verfügung steht. Wir verwenden daher Bandgap-selektives photoelektrochemisches Ätzen, um eine Opferschicht selektiv zu unterätzen, während die aktive Schicht nicht angegriffen wird. Wir stellen unsere Ergebnisse zur erfolgreichen Herstellung solcher Membranen vor. Wir stellen auch FDTD Simulationen vor, um die Eigenschaften dieser Defekte in GaN zu diskutieren.

HL 54.4 Di 15:45 TU P164

Investigation on fabrication-related disorder in three-dimensional macroporous silicon photonic crystals — •Sven Matthias, Frank Müller, Reinald Hillebrand, and Ulrich Gösele — Max Planck Institute of Microstructure Physics; Weinberg 2; D-06120 Halle; Germany

Recently it was demonstrated that different kinds of simple cubic three-dimensional photonic crystals could be fabricated in macroporous silicon possessing a complete photonic bandgap. We will focus in detail on the photoelectrochemical etching process and its important parameters. The fabrication-related disorder is investigated by FTIR-spectroscopy and SEM pictures. We will figure out, how several parameters of the fabrication process influence the degree of disorder. A route towards an optimized three-dimensional photonic crystals based on macroporous silicon will be given.

HL 54.5 Di 16:00 TU P164

Fabrication of photonic crystals and templates by two-photon polymerization technique — •Aleksandr Ovsianikov[1], Ruth Houbertz[2], and Boris Chichkov[1] — [1]Laser Zentrum Hannover e.V. — [2]Fraunhofer-ISC Würzburg

Two-photon polymerization (2PP) is a powerful technology for the fabrication of 3D structures with submicrometer resolution. In this contribution we present our recent results on the fabrication of woodpile photonic crystal structures and investigation of their optical properties. The specific applied photosensitive materials are ORMOCER and SU8. Photonic crystals fabricated in these materials exhibit a bandgap in the near infrared spectral region. First results of template fabrication for the realization of high refractive index Ti:O2 replicas will be demonstrated.