HL 17: Invited Talk Limmer

Time: Tuesday 10:00–10:45 Location: H15

Invited Talk HL 17.1 Tue 10:00 H15

Magnetic anisotropy and magnetization switching in ferromagnetic GaMnAs — •Wolfgang Limmer — Institut für Halbleiterphysik, Universität Ulm, 89069 Ulm, Germany

Characteristic features of semiconductor spintronics such as the anisotropic magnetoresistance or the spin-polarization of charge carriers are intimately connected with the macroscopic magnetization in a ferromagnetic semiconductor. The orientation of the magnetization is controlled by magnetic anisotropy which predominantly arises from crystal symmetry, sample geometry, and strain. A detailed knowledge of this anisotropy is indispensable for the design of novel spintronic devices.

In this talk, angle-dependent magnetotransport is demonstrated to be an excellent tool for probing magnetic anisotropy as an alternative to the standard ferromagnetic-resonance method. Moreover, its ability to trace the movement of the magnetization vector in a variable external magnetic field makes it ideally suitable for studying magnetization switching, a potential basic effect in future logical devices. Experimental data recorded from a variety of different GaMnAs samples are analyzed by means of model calculations which are based on a series expansion of the resistivity tensor, a numerical minimization of the free enthalpy with respect to the magnetization orientation, and the assumption that the GaMnAs layers under study consist of single ferromagnetic domains.

HL 18: Photonic crystals I

Time: Tuesday 10:45–12:45 Location: H13

HL 18.1 Tue 10:45 H13

Photonic Crystal functional elements based on optically anisotropic materials and large-scale devices — •Patrick Mack[1,2], Daniel Hermann[1], Matthias Schillinger[1], Sergei Mingaleev[1,3], and Kurt Busch[1] — [1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe (TH), Germany — [2]Institut für Nanotechnologie, Forschungszentrum Karlsruhe, Germany — [3]Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine

We present device designs in macroporous silicon photonic crystals based on the infiltration of individual pores with liquid crystals which yield actively tunable photonic devices. These designs have been developed via a photonic Wannier function approach that allows the characterization of such devices via complex transmittance and reflectance coefficients. As a result, individual devices may be represented by small frequency-dependent scattering matrices. In turn, these scattering matrices form the basis of a quantitative circuit theory that allows to design complex functional elements that are very hard to handle with other simulation techniques.

HL 18.2 Tue 11:00 H13

Fabrication of 3D photonic crystal structures by two-photon polymerization technique — •Aleksandr Ovsianikov and Boris Chichkov — Hollerithallee 8

Two-photon polymerization technique can be considered as an enabling technology for the fabrication of 3D photonic crystals, especially those with introduced defects. Here, we report on our recent progress in the fabrication of 3D polymeric photonic crystals and investigation of their optical properties. Most of the materials used for 2PP were developed for lithographic applications and have a refractive index of the order of 1.6. We have investigated many of such materials and their structurability by 2PP technique. Further prospects of 2PP technology will be discussed.

HL 18.3 Tue 11:15 H13

Plasmon hybridization in stacked cut-wire metamaterials near metal films — •na liu[1], hongcang guo[1], liwei fu[1], heinz Schweizer[1], stefan kaiser[2], and harald giessen[1] — [1]4. Physikalisches Institut,Universitaet Stuttgart, Pfaffenwaldring 57, 70500, stuttgart, Germany — [2]1. Physikalisches Institut,Universitaet Stuttgart, Pfaffenwaldring 57, 70500, stuttgart, Germany

Abstract: We introduce a simple and convenient method to stack artificial units for metamaterials in the third dimension. Cut-wires and cut-wire pairs are placed above a metal film so that image cut-wires or cut-wire pairs are induced by the metal mirror when illuminated by light [1], which is equivalent to stacking two or four layers of cut-wires. The optical properties of cut-wires and cut-wire pairs above metal mirrors are investigated experimentally and numerically. The resonant plasmon modes are interpreted utilizing directly stacked cut-wire structures according to the method of plasmon hybridization [2]. Furthermore, the frequencies of different plasmon modes as a function of cut-wire separation are explored numerically. This method should pave the road towards a fundamental understanding of the electronic and optical properties of 3D metamaterials.

[1] V. A. Podolskiy, A. K. Sarchev, and V. M. Shalaev, Opt. Express 2003, 11, 735. [2] E. Prodan, C. Radloff, N. J. Halas, and P. Norlander, Science 2003, 302, 419.

HL 18.4 Tue 11:30 H13

Wasserstoffsensor auf Basis metallischer photonischer Kristalle — •Regina Orzekowsky, Andreas Seidel und Harald Giessen — 4. Physikalisches Institut, Universität Stuttgart, Germany

Aus Sicherheitsgründen sind günstige Wasserstoffsensoren Voraussetzung für die marktreife Umsetzung von wasserstoffbetriebenen Fahrzeugen oder elektronischen Geräten. Bisher sind Wasserstoffsensoren sehr teuer und benötigen elektrische Leitungen in einer potentiell explosionsgefährdeten Umgebung. Wir stellen einen optischen Wasserstoffsensor auf Basis eines metallischen oder dielektrischen photonischen Kristalls vor. Wir verwenden dabei eine Wolfram-Trioxid-Wellenleiterschicht unter einem Gitter aus metallischen oder dielektischen Nanodrähten. Die Nanostrukturen werden mit Interferenzlithographie oder Elektronenstrahllithographie hergestellt. Die optischen Eigenschaften der Wellenleiterschicht und somit die Polaritonresonanzen des metallischen photonischen Kristalls werden durch den gasochromen Effekt verändert. Das Detektionsprinzip wird erklärt und die Funktionsweise des Wasserstoffsensors experimentell nachgewiesen. Da unser Detektionsprinzip auf einem optischen Effekt beruht, kann das sensitive Element von der Elektronik isoliert und dadurch sicherer werden. Wir erwarten, daß dieser Sensor sowohl billiger in der Herstellung als herkömmliche Wasserstoffsensoren sein wird, als auch gleichzeitig robust, klein und wiederverwendbar.

HL 18.5 Tue 11:45 H13

Fabrication of silicon inverse woodpile photonic crystals — •Martin Hermatschweiler[1], Martin Wegener[1,2], Geoffrey Allen Ozin[3], Alexandra Ledermann[2], and Georg von Freymann[2] — [1]DFG-Center for Functional Nanostructures (CFN) and Institut für Angewandte Physik, Universität Karlsruhe (TH), 76131 Karlsruhe — [2]Institut für Nanotechnologie, Forschungszentrum Karlsruhe in der Helmholtz-Gemeinschaft, 76021 Karlsruhe — [3]Department of Chemistry, University of Toronto, Toronto, Ontario M5S 3H6, Canada

We fabricate silicon inverse woodpile structures for the first time. Direct laser writing of polymeric templates and a novel silicon-single-inversion procedure [1] lead to structures with gap/midgap ratios of 14.2% centered at 2.5 μm wavelength.

First, polymer templates are fabricated by direct laser writing or other means. Next, we deposit a thin silica coating via atomic layer deposition (ALD) on the polymer and - without removing the polymer - infiltrate the composite structure with Si via Si chemical vapor deposition (CVD). The silica shell provides sufficient and reliable stabilization for the high temperature CVD process. Finally, the silica is etched out and the polymer is calcined in air, leading to a Si inverse woodpile structure. Optical measurements and comparison to bandstructure and scattering-matrix calculations reveal a gap/midgap ratio of 14.2% centered at 2.5 μm. An optimized structure could open a band