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UNIVERSITÄT BERN

Seminar über Ultrafast Science and Technology

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Titel: Functionalized materials and high resolution measurement techniques in the THz regime

The terahertz (THz) regime is an important spectral region for applications from biomedicine and food technology to security and telecommunications. Recently, several platforms for studying quantum phenomena have been developed in this frequency range. In this talk, I will present my research in the THz regime, using mainly terahertz time domain spectroscopy (THz-TDS) and introduce my recent and future work in the THz regime. THz-TDS is a powerful tool for material characterization and identifica-tion. During my research, I have characterized numerous materials with THz-TDS, namely liquid crystals (LCs), nanoparticles, semiconductors and superconductors. Firstly, I will describe the parameter extraction algorithm we have developed for the extraction of the optical parameters of materials. With this algorithm, we were able to determine the birefringence of LCs and the increase of the birefringence while we doped the LCs with ferroelectric BaTiO3 particles 1,2. In addition, we developed a refractive index solution (TeraSol) based on BaTiO3 particles; it has a tuna-ble refractive index between n=1.8 and n=5 3, optimized to match the refractive indices of materials widely used in the THz regime (Fig. 1).
As the THz regime is a playground for quantum phenomena, we simulated and fabricated a Fabry Perot cavity based on gallium arsenide and quantum wells. For this work, we used a THz-TDS system while our samples were exposed to high magnetic fields. The cavity and the mirrors were designed such that the resonance frequency of the cavity was at 280 GHz. We observed ultra-strong coupling in order of <40 % of light matter coupling and the Q factor of the cavity was Q> 100 at the first mode.
Regarding my work on THz quantum cascade lasers (QCL), we exploited THz-TDS for the determina-tion of the active region doping and we designed and fabricated antennas (Vivaldi) in order to improve the beam profile of the THz QCLS devices.
In the last part, I will introduce our recent work on developing a THz scattering-type scanning near-field microscope (s-SNOM) for high resolution imaging of 2D materials and characterizing the electric properties of the materials. Finally, I will show our results on the optimization process of THz printing of cyclic olefin copolymer for THz waveguides and lenses.

Zeit: Donnerstag, 10.10.2019, 11.15h

Ort: **Hörsaal B116**, Gebäude Exakte Wissenschaften, Sidlerstrasse 5, Bern, Schweiz