HL 15: Invited Talk Fritz Henneberger

Time: Monday 15:00–15:30 Location: EW 203

Invited Talk HL 15.1 Mon 15:00 EW 203

Semiconductor-based plasmonics — •Fritz Henneberger, Sascha Kalusniak, and Sergey Sadofev — Humboldt Universität zu Berlin, Institut für Physik, Newtonstr. 15, 12489 Berlin

When targeting the infrared spectral range in plasmonics, traditional metals like gold and silver suffer from strong losses and weak localization. We show that heavily doped n-type ZnO (and other oxide semiconductors) are excellent alternatives including even telecommunication wavelengths. Using MBE, free carrier concentrations of almost 10^{21} cm^{-3} can be generated by Ga-doping of ZnO without significant deterioration of the crystalline structure. In this way, a metallic permittivity emerges with losses at least one order of magnitude lower than for traditional metals and a negative real part tuneable from mid infrared wavelengths to 1.2 μm. Epitaxial multi-layer structures with different doping level enable the demonstration of novel surface plasmon polaritons (SPPs) with dispersions that can be engineered in a unique way. In particular, SPPs at metal/metal-type interfaces exhibit finite frequencies in the long-wavelength limit, in marked contrast to metal/dielectric SPPs. Further, we resonantly and coherently couple these SPP states to molecular vibrations and observe profound changes of the molecular line shape when adjusting the resonance detuning. Negative refraction at 1.55 μm is achieved by strong SPP-photon coupling in a microcavity setting formed by multi-layer film structures, as commonly used in waveguide optics. Increasing the layer number towards the effective-medium regime, a compact hyperbolic metamaterial is built-up exhibiting, e.g., extraordinary transmission.