Seminarankündigung

Dienstag, 07. Juni 2011
17:15 Uhr

WSI, Seminarraum S 101

"Control and manipulation of spontaneous emission using dielectric and metallic nanostructures"

Nanostructured dielectric and metallic materials provide strong potential to manipulate and control the light matter interaction with such precision that one can reach the quantum limit of a single field mode interacting with an individual emitter. In particular, coupling individual discrete semiconductor emitters, such as optically active quantum dots, to such tailored photonic materials provides the potential to control the direction and rate at which spontaneous emission occurs and even guide light between different locations on the same semiconductor chip. In this talk, I will review our work in which we employ such textured photonic nano-materials to manipulate and control the spontaneous emission from semiconductor quantum emitters. I will begin by discussing electrically tunable single quantum dot (QD) - photonic crystal (PC) defect nanocavities operating in both the weak and strong coupling regimes of the light matter interaction. By using the quantum confined Stark-effect to control the exciton-cavity detuning we probe the response of the system as a function of external control parameters, such as excitation level or lattice temperature. These studies reveal information about dephasing arising from incoherent excitation and the fluctuating quantum dot environment. These results will be contrasted with studies of single QDs coupled to propagating field modes in PC waveguides, where the modified density of modes in the PC waveguide results in highly directional emission. Estimates show that □>85% of the emitted photons generated in the propagating waveguide mode. Photon autocorrelation measurements prove the single photon nature of the dot emission into waveguide mode, demonstrating a highly efficient and directed "on-chip" single photon source. Results obtained on III-V photonic nanostructures will then be contrasted with PC nanostructures fabricated in the Si-Ge materials system. Here, the use of cavity QED phenomena enhances the intensity of the emission at room temperature by >400x. Finally, preliminary studies of lithographically defined gold waveguides will be presented. Clear evidence for guided surface plasmons is obtained, providing excellent perspectives to unify PC and plasmonic nanostructures and achieve complete control of the distribution, routing and light-matter interaction strength on a chip over sub-wavelength lengthscales. Such systems are likely to have strong potential for future photonic and quantum electronic devices.

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