Einladung zum

Wiener Physikalischen Kolloquium

CONTROLLING OPTICAL TRANSITIONS IN CARBON NANOTUBES BY SURFACE PLASMONS

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Single-walled carbon nanotubes (SWCNTs) are potential candidates for device applications in photonics and optoelectronics. The excited states of semiconducting SWCNTs are formed by strongly bound luminescent excitons that can be produced either by optical or electrical means. Exciton recombination can lead to photoluminescence (PL) with emission energies in the near-infrared range.
We investigate the coupling of the optical transitions in nanotubes to localized as well as propagating surface plasmons in metal nanostructures. We first show that the nanotube photoluminescence can be enhanced and spatially redirected by coupling to localized surface plasmons provided by a sharp metal tip (Figure 1(a)). The metal tip is found to act as an optical antenna enhancing both excitation and spontaneous emission rate of the SWCNT. By raster-scanning the antenna we obtain near-field PL and Raman scattering as well as photocurrent images of single SWCNTs and other nanostructures at a spatial resolution of about 20 nm, far below the diffraction limit.

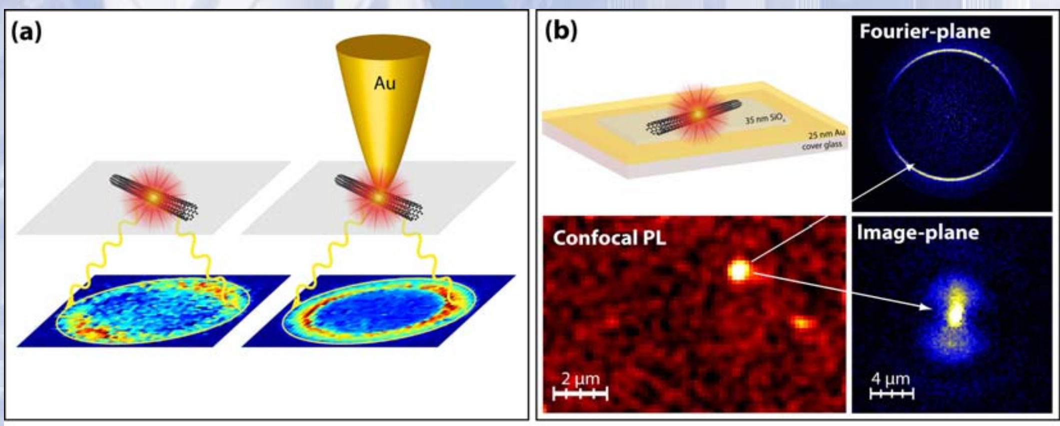

Fig. 1 (a) Coupling of nanotube PL to localized plasmons in a metal antenna tip: Radiation pattern detected in the Fourier-plane of the microscope for a single carbon nanotube with and without optical antenna. (b) Coupling of PL to propagating surface plasmons in a thin gold film: Confocal, Fourier-plane and real-space PL images.

We then report on the excitation of propagating surface plasmon polaritons in thin metal films by PL emission from single SWCNTs. A single carbon nanotube is shown to act as a directive point dipole source for surface plasmons propagating along the direction of the nanotube axis (Figure 1(b)). Combining surface plasmon coupling with electroluminescence from carbon nanotubes opens up the possibility to create an electrically driven nanoscale plasmon source.

Montag, 21. Mai 2012, 17:30 Uhr
(ab 17:00 Uhr Kaffee)

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