MAR05-2004-000062

Abstract for an Invited Paper
for the MAR05 Meeting of
the American Physical Society

Tip-confined near fields for locally probing optical constants and fluorescence

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Nanoscopic light focusing occurs near nanoscale optical/infrared antenna structures (eg small particles or AFM tips), through dielectric and geometric physical mechanisms. Such highly confined light probes linear optical/infrared properties at <20 nm spatial resolution, in two realizations. (i) Scattering-type SNOM employing tapping AFM, free-space illumination, and heterodyne detection. This works well with even long-wavelength infrared. Maps of topography and of complex light scattering efficiency are simultaneously recorded. The latter can determine the local complex optical index or dielectric function as has been shown, by electrostatic modelling, with free electrons in doped semiconductors, phonon resonance in polar crystals, nanocomposite polymers, and proteins. (ii) Tip-on-aperture SNOM employing fiber-guided illumination through an aperture on which a metal tip is grown. Tip-confined fluorescence imaging of single, DNA-tagging fluorophores has been achieved together with high-resolution topography, at negligible interference from background illumination or photobleaching. (i) Keilmann&Hillenbrand, Phil. Trans. R. Soc. Lond. A 362, 787 (2004); (ii) Frey&Guckenberger, Phys. Rev. Lett., in print.