LOCAL MEASUREMENT OF THE ELECTRIC PERMITTIVITY BY USING SCATTERING SCANNING NEAR-FIELD OPTICAL MICROSCOPY

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Scanning Near-field Optical Microscopy (s-SNOM) is a complex optical microscope that gained much interest in the past couple of decades. It is capable of sub-wavelength resolution based on the AFM tip size.

In our work we used an s-SNOM module upgrading an AFM [1]. Our work demonstrates both theoretically and experimentally that s-SNOM is capable of electric permittivity determination in visible region with sub-wavelength resolution. Using the oscillating point-dipole model (OPDM), a proportionality relation is established between the theoretical and the experimental results, based on well-known experimental conditions (functioning parameters of the system, investigated sample). For determination of both real and imaginary parts of the electric permittivity of an unknown material, two investigations are necessary, with detection on two successive spectral components of the signal. Introducing the experimental data in the OPDM model, the complex electric permittivity of the unknown material is thus determined.

However, for high efficiency of the method, a good understanding of the influence of the functioning parameters on the image contrast is required. Thus, the oscillation amplitude of the reference mirror (part of the pseudo-heterodyne interferometric scheme, used for s-SNOM detection) has been demonstrated to highly influence the contrast of s-SNOM images [2]. Carefully adjusting of the parameters can provide good image contrast even for samples with close electric permittivities. Good image contrast, together with the possibility of local electric permittivity measurements, promote s-SNOM imaging as a good investigation tool for biological and medical samples.

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