Pseudo-heterodyne scanning near-field optical microscope for surface plasmon detection with actively stabilized phase

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Amplitude and phase of the evanescent surface plasmon field were detected by a pseudo-heterodyne scanning near-field optical microscope (SNOM). Light from a HeNe laser (λ = 633nm) and an argon ion (Ar) laser (λ = 488nm) was combinied in a fiber coupler. One output channel of the coupler served as reference branch of an interferometer. A piezoelectric fiber stretcher in that branch was used for sinusoidal phase modulation. The other output of the coupler was linked to another coupler. By using different color filters, the two wavelengths were separated at the output channels. The HeNe laser was used for surface plasmon excitation under attenuated total internal reflection. The light from the Ar laser illuminated the sample under normal incidence, so that during the scanning process a constant phase from the Ar laser was detected. The SNOM tip detects both, surface plasmons excited by the HeNe laser and the spot from the Ar laser. The signal is combined in a third fiber coupler with the signal from the reference branch. At the output, the interference signal was wavelength- selectively detected by Si photodiodes and lock-in amplifiers. The signal from the Ar laser was used as input for a feedback- loop which modifies the drive signal of the fiber stretcher. In this way, the phase fluctuations due to thermal and mechanical disturbances were compensated.