Optimal plasmonic microscopic sensing with TM-only polarization

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Surface plasmon (SP) is collective oscillation of free electrons at metal/dielectric interface. Since its extraordinary high sensitivity to small variations of dielectric material, SP has been very attractive for sensing in biological applications. Sensitivity given in terms of the minimum detectable change has always been considered and optimized as the most important specification in bio-sensor; however, a sensor with poor lateral resolution is quite difficult to measure highly localized area accurately not to mention the amount of rare or precious analysts in one measurement. Therefore, it is quite imperative to develop SP sensors with high sensitivity and high lateral resolution simultaneously. In previous publication[Opt. Express, vol. 20, 7388-7397(2012)], we have developed a confocal setup based SP interferometric sensor which could measure localized surface plasmon (SP) on the order of diffraction limitation much smaller than the SP propagation distance without decreasing the ultra-high sensitivity of SP. Here we show how the noise performance and dynamic range of confocal surface plasmon microscopy can be optimized with TM-only polarization using oil immersion lens of 1.25NA. Fig.1 (a) and (b) shows the pupil filter pattern and its interferogram by linearly polarized beam and TM-only mode. It is obviously that the dynamic scan range has been optimized from 1um to 10 um and the signal has been enhanced for nearly 8 times, from 4.2% to 32%. This method shares the advantages of radially polarized mode and thus increase the SP excitation amount however avoids the problem of ‘hollow heart’ of radially polarized beam when using objective NA less than 1.43.

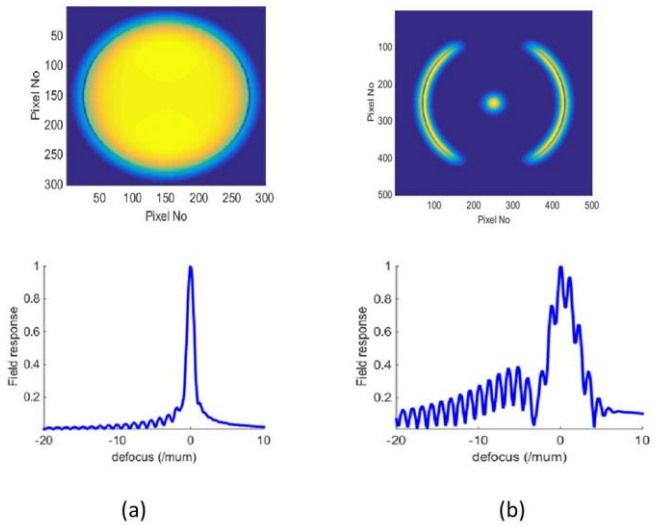

Fig. 1 Pupil filter pattern and SP excitation ‘crescent shape’ using whole beam and only TM-only mode