Nanoplasmonics and surface enhanced spectroscopy

Control of plasmons excitation by P- and S-polarized light on Au nanowire gratings by azimuthal angle variation

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Plasmonic gratings (mostly Au gratings) that support both localized plasmons (LP), and propagating surface plasmon polaritons (SPP), have found wide use in recent years in numerous fields of research and applications. In the gratings with small relief depth, surface plasmons are propagating, however, if the grating has large depth of relief or consists of nanowires, increasing the slit width between nanowires eventually results in LP excitations in isolated nanostripes. Many studies have been devoted to investigation of the transition between the regimes of LP and SPP in Au gratings with a variable depth of relief and filling factor. Here we report on the results of experimental investigation of LP and SPP excitation on Au nanowire gratings with variable angle between the plane of incidence of P- or S-polarized light and the grating wave vector (azimuthal angle).

We used the technology of interference lithography (IL) and vacuum chalcogenide photoresist for patterning of the Au layer with spatial frequency 3370 $\pm$ 5 mm^{-1} and depth of relief equal to thickness of Au layer (45 nm). The surface patterns of obtained nanowire gratings were examined with a Dimension 3000 scanning probe microscope (Digital Instruments).

Optical properties of fabricated plasmonic structures were studied using measurements of spectral and angular dependence of transmission and reflection of polarized light in the wavelength range 0.4-1.1 microns, angles of incidence of 10 - 80 degrees and azimuthal angles of 0 - 90 degrees. Such measurements allow to build the dispersion curves of excited optical modes and to identify their type.

The results of optical measurement confirm the possibility to control, by azimuthal rotating of the grating, of the transition between the regimes of plasmons excitation by P-polarized light (at small azimuthal angles) to excitation by S-polarized light (at azimuthal angles near 90 degrees). The relationship between LP and SPP excitation depends on the isolation of Au nanowires from each other.