Nanoplasmonics and surface enhanced spectroscopy

Plasmonic structures fabricated by interference lithography for experimental study of localized and propagating surface plasmons on Au gratings

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Periodic plasmonic structures has found wide use in recent years in numerous fields of research and applications, for example as a substrate for optical sensors based on plasmon resonance, or surface-enhanced Raman spectroscopy, as a sub-wavelength optical elements, and others.

One of the most technological method for fabrication of periodic nano- and microstructures is interference lithography (IL). Here we report the IL technique with the use of vacuum resist for the formation of one-dimensional (gratings) periodic patterns on the surface of Au layers and studies the influence of Au thickness on features of excited plasmons in such periodic structures.

The IL technique was optimized for patterning of the Au layer with spatial frequency 3370 ± 5 mm^{-1} and depth of relief equal to thickness of Au layer (40 nm). After that the set of samples were prepared by successive thermal vacuum evaporation of 10-nm Au layers onto patterned structure. The surface patterns of obtained samples 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 and angles of incidence of 10 - 80 degrees. Such measurements allow to build the dispersion curves of excited optical modes and to identify their type.

Thus, IL technology using vacuum photoresist is expected to be used as a powerful and flexible tool for the rapid fabrication and optimization of large areas submicrons plasmonic structures. The results of optical measurement confirm the excitation of surface plasmon-polariton and local surface plasmon resonance in fabricated samples, spectral and angular position of which coincides with the predictions of the theory, and can be adjusted over a wide range by selecting the geometric parameters of structures and technological modes of their manufacturing.