Dual plasmon excitation imaged by leakage radiation microscopy

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Surface plasmons, originated by the collective oscillations of conduction electrons at a metal-dielectric interface, have attracted a lot of interest over the last decades. This research is motivated by the current trends for optical device miniaturization, associated with the plasmon-assisted enhancement of optical activity. One of the important features of the metal-dielectric interface is the capability to convert an incident electromagnetic wave with wavevector k_0, to a surface plasmon with wavevector k_{sp}, yet this conversion cannot be done directly by light. However, several strategies can be applied to perform the coupling between light and plasmons, based on the interaction of light with different structures, including gratings, cavities, slits or prisms.

In the present work we have adopted a prism-coupling strategy based on Kretschmann configuration, in which the role of the prism is played by an oil immersion objective. In our setup, the latter is able to collect the lekage radiation of plasmons that are converted back to light.[1]

We have used the leakage radiation microscopy to image surface plasmons in real space. For that purpose, we have designed metallic nanostructures (slits, dots and gratings), by optical and e-beam lithography, allowing a dual surface plasmon excitation. A first kind of plasmons is generated by the Kretschmann configuration when the angle of incidence is higher than the critical angle and propagates along the plane of incidence. A second set of plasmons are generated by surface corrugation, with propagation modes determined by the corrugation geometry. The possibility of this dual plasmon excitation has enabled us to explore the interaction between them, either in real or in reciprocal space. The results may be of relevance for the development of methods to manipulate the propagation of surface plasmons in metal/dielectric nanostructures.

References: [1] A. Bouhelier and G.P. Wiederrecht. Phys. Rev. B, 2005