Exploration of laser induced gratings coupled to surface plasmon polaritons

Manfred Niehus
DEETC/ISEL, R. Conselheiro Emídio Navarro 1, Lisboa, Portugal
mniehus@deetc.isel.ipl.pt

Since the discovery of the extraordinary transmission enhancement through subwavelength hole arrays [1] the interest in surface plasmon polaritons has been on the rise, not just due to the astonishingly complex nature of single and coupled electronic, photonic and plasmonic modes and resonances in hybrid metal/dielectric structures on the nanometerscale [2], but also as it allows to engineer plasmonic metamaterials on the nanoscale [3]. Astonishing plasmon-correlated benchmark achievements include the transmission of entangled photons [4], enhanced LED emission [5] or the demonstration of TeraHertz radiation [6].

It is well known since the 1980ies [7] that the coupling between photons and surface plasmon polaritons has to be accomplished through a special coupling in order to assure wavevector conservation, or through Kretschmann configuration, or through a periodic lattice with a constant near to the wavelength of light.

The study of laser induced gratings has been established at about the same time [8]. It allowed to impose a grating period length scale onto a sample and to study its decay by time. Plenty of diffusion processes have been measured that way. Besides the optical detection techniques (with all over limited detection efficiency), electrical detection schemes were developed for the steady-state [9] and time-induced measurements [10].

The use of coherent frequency-shifted laser beams in grating experiments (photomixing) leads to moving photo-carrier gratings and represents an important technique for the generation of TeraHertz radiation [11].

To our knowledge, the surface plasmon polariton coupling of laser induced gratings was not yet explored . We will present in this contribution the outline of our experiments on highly doped semiconductors, the theoretical simulations, and the preliminary experimental results, and discuss them in the light of recent literature concerning the mode formation in one-dimensional gratings.

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