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Ellipsometric investigation of interaction and Rabi splitting of surface and localized plasmons

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It is well known that two interacting resonances hybridize and split producing energy gap between two hybridized modes instead of two independent resonances. Different parameters of interacting systems play role in the determination of such a splitting. The most popular system for the investigation of such an interaction is a molecular layer on the surface of a metal supporting surface plasmon [1]. Regulating the distance between the layer with molecular exciton and the surface allows to control the strength of the exciton-plasmon interaction. However bleaching and no possibility to regulate parameters for chosen molecules restrict the flexibility of such investigations. The exchange of the layer of molecules by nanoparticles possessing localized plasmon makes such a system more convenient for investigations. Possibilities to manage parameters of localized plasmon by size, shape and the concentration of nanoparticles opens new perspectives for such a task.
Spectroscopic investigations of such a system were already reported [2]. In the present work we used ellipsometry to check plasmonic interactions. Ellipsometry is a method, which allows to register plasmon resonance position and to monitor not only amplitude but phase information too. The latter is important for the reconstruction of the whole picture of the interaction and splitting as well as allows to obtain information about near-field local interactions from parameters of far field. Obtained results clearly demonstrate splitting of resonances and different effectiveness of the energy transfer at different angles of incidence. We hope the simultaneous registration of amplitude and phase characteristics of resonances would allow to reveal the spectral shift between near-field and far-field resonances.

[1] P. Törmä and W.L. Barnes, Rep. Prog. Phys. 78 (2015) 013901.
[2] A. Rueda, M. Stemmler, R. Bauer, Yu. Fogel, K. Müllen, and M. Kreiter, J Phys Chem C 112 (2008) 14801.