Comment on "Interaction between optical nano-objects at metallo-dielectric interfaces" by P. Lalanne and J. P. Hugonin

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The authors of [1] state that their numerical calculation of the transmission intensity dependence of very simple subwavelength planar structures in a silver film agrees well with an earlier-developed model [2], but both model and numerical simulation show significant disagreement with the experimental results of [3]. They speculate that the silver surfaces of the subwavelength structures used in Ref. [3] were contaminated by an 11 nm overlayer of silver sulfide since such a layer would bring the reported experimental results and their calculations into better agreement. We have analysed the physical-chemical surface properties of the single-slit, single-groove subwavelength-structured silver films used in the experiments with high-resolution transmission electron microscopy (TEM), and we have calculated fully vectorial numerical solutions to Maxwell's equations for the relevant structures using the finite-difference-time-domain (FDTD) technique [4]. The TEM analysis shows that the silver films are free of detectable contaminants with a detection limit orders of magnitude below the 11 nm layer suggested by Ref. [1]. Furthermore the FDTD calculations are in excellent agreement with experiment, showing a rapid fringe amplitude decrease in the near-zone (slit-groove distance out to 3-4 wavelengths). Extended FDTD calculations to slit-groove distances beyond the near-zone show that the surface wave evolves to the expected bound surface plasmon polariton (SPP). The key finding is that surface wave in the near-zone consists of a *distribution* of transient surface modes adjacent and in addition to the bound SPP. Beyond the near-zone the results confirm that the transients dissipate with only the bound SPP mode surviving. This result has important implications for the interpretation of light transmission through arrays of subwavelength structures with subwavelength pitch. The common assumption that only the SPP mode is populated over the entire surface is not justified in the near-zone.

[1] P. Lalanne and J. P. Hugonin, Nature Phys. **2**, 551-558 (2006).
[2] P. Lalanne, J. P. Hugonin, and J. C. Rodier, Phys. Rev. Lett. **95**, 263902 (2005).
[3] G. Gay, et al. Nature Phys. **2**, 262-267 (2006).
[4] G. Gay et al., arXiv:physics/0608116 v2 (2006).

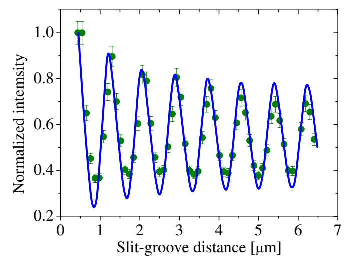

FIG. 1: Comparison of FDTD simulation and experiment. Green points are experimental data taken from [3]. Blue curve shows the FDTD result.

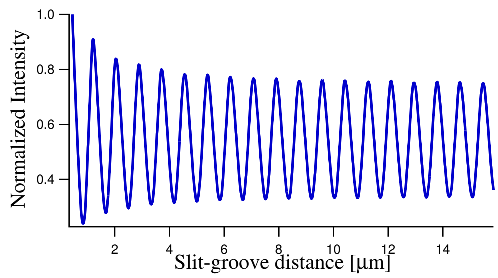

FIG. 2: Blue curve plots the same FDTD calculation as in Fig. 1 but extended to 16 μm slit-groove distance.