Polarimetric analysis of the extraodinary optical transmission through subwavelength hole arrays

Oriol Arteaga,[1,2] Ben M. Maoz,[3] Shane Nichols,[2] Gil Markovich,[3] Bart Kahr[2]

[1]Department of Applied Physics and Optics, IN[2]UB, C/ Martí i Franqués 1, Universitat de Barcelona, Barcelona, 08028 Spain.
[2]Department of Chemistry, 100 Washington Square East, Room 1001, New York University, New York NY, 10003 USA
[3]Department of Chemical Physics, School of Chemistry, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv, 69978 Israel

oarteaga@ub.edu

In this work we examine the complete polarimetric response of oblique- and square- lattices of metal subwavelength hole arrays that display extraordinary optical transmission [1] at certain frequencies mediated by the excitation of surface plasmons. The study is based on the analysis of the Mueller scattering matrix measured at normal and oblique incidences for plane wave illumination. At normal incidence the square lattice of nanoholes shows a fully isotropic optical response, i. e. it does not alter the polarization of incoming light. However, the oblique lattice has an anisotropic response that, at some wavelengths, gives rise to optical activity and assymetric transmission of circularly polarized light. This complex optical response is due to the coupling of the linear optical anisotropies induced by misaligned surface plasmons in the film. At oblique incidence the square lattice also shows asymmetric transmission at non-normal incidence, whenever the plane of incidence does not coincide with a mirror line (Fig.1).

References

[1] T. W. Ebbesen, H. J.Lezec, H. F. Ghaemi, T, Thio, P. A. Wolff, “Extraordinary optical transmission through sub-wavelength hole arrays” *Nature, 391*, 667 (1998).

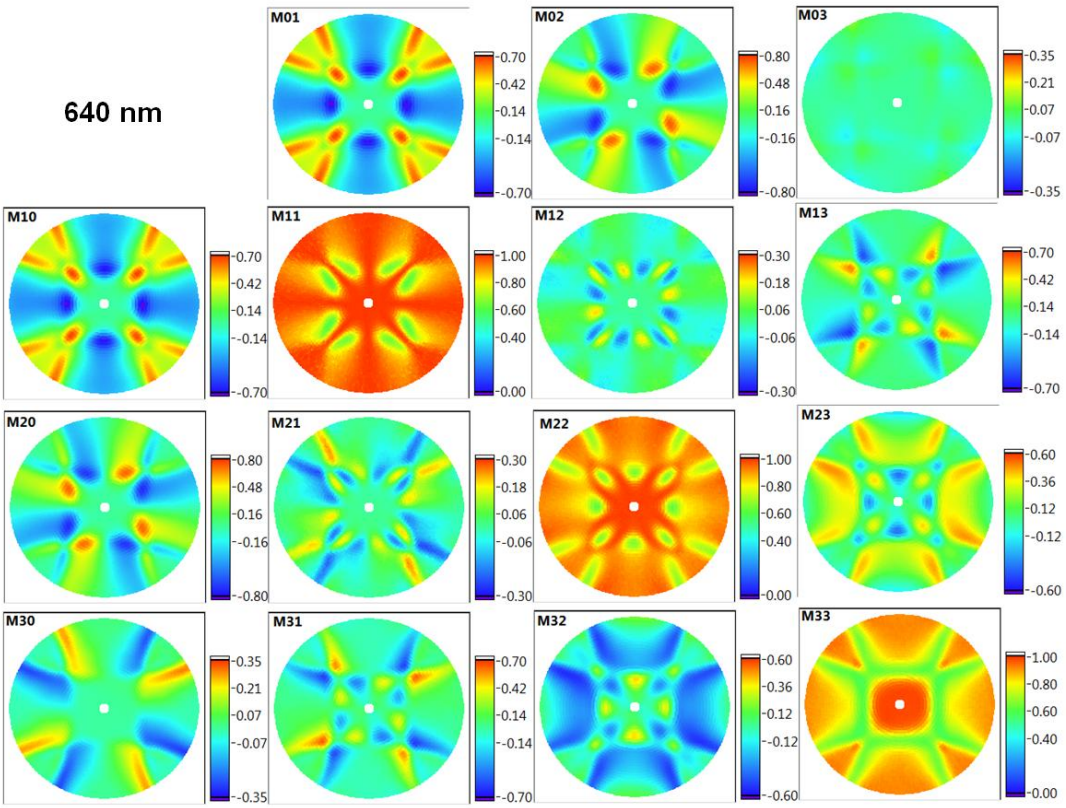

Figure 1. Normalized Mueller matrices measured for a square nanohole array at 640 nm. The Mueller matrix elements are plotted in polar coordinates. The radius is given by the angle of incidence, and the polar angle by azimuthal rotation angle in the plane of the sample.