HOW LIGHT EMERGES FROM AN ILLUMINATED ARRAY OF SUBWAVELENGTH HOLES

J. Bravo-Abad[1], A. Degiron[2], F. Przybilla[2], C. Genet[2], F.J. García-Vidal[1], L. Martín-Moreno[3], and T.W. Ebbesen[2]

[1]Departamento de Física Teórica de la Materia Condensada, Universidad Autónoma de Madrid, E-28049 Madrid, Spain
[2] ISIS, Université Louis Pasteur, 67000 Strasbourg, France
[3] Departamento de Física de la Materia Condensada, Universidad de Zaragoza-CSIC, E-50009 Zaragoza, Spain.
jorge.bravo@uam.es

The extraordinary optical transmission through periodic arrays of subwavelength holes has been studied extensively since it was first reported in 1998, owing to both its fundamental implications and its technological potential. The picture of the underlying mechanism that emerges from most of the theoretical studies is a resonant process assisted by surface electromagnetic modes, such as surface plasmons. However, these studies consider an infinite array of holes. By combining experiment and theory, we have analyzed the influence of the inherent finite size of the arrays and report here the unexpected spatial distribution of light as it emerges from the arrays. This distribution is strongly anisotropic and extremely sensitive to the angle of incidence of the impinging light. The behavior can be explained by a model that takes into account the asymmetry induced by the array edges, and the effects this has on the emission pattern across the array.

Reference:

[1] J. Bravo-Abad, A. Degiron, F. Przybilla, C. Genet, F.J. García-Vidal, L. Martín-Moreno and T.W. Ebbesen, Nature Physics **2**, 120 (2006).

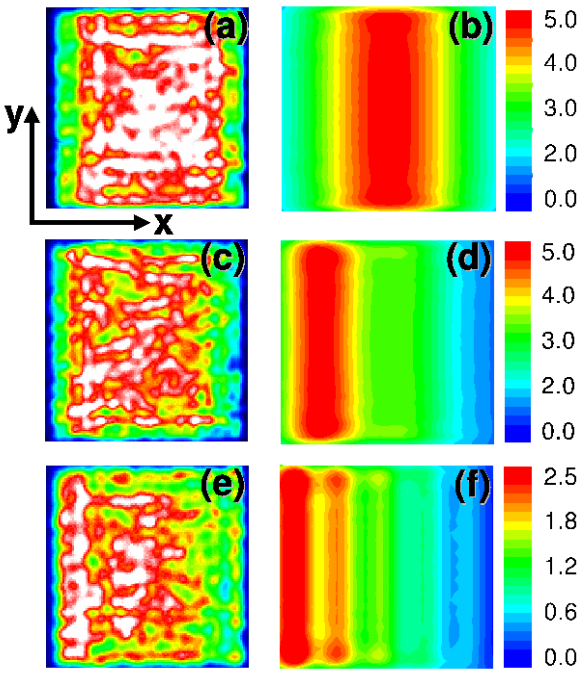

Figure: Transmission per hole at resonance through a 31x31 hole array of subwavelength holes. Left panels show the experimental emissivity, while the right panels display the theoretical transmission per hole. Three different values for the incident angle θ are considered: (a),(b) correspond to θ=0°, (c),(d) to θ=2° and (e),(f) to θ=5°.