Far-Field Subwavelength Focusing of Light and Plasmons by the Talbot Effect

Fu Min Huang[1], Mark Dennis[1], F. Javier Garcia de Abajo[2] and Nikolay Zheludev[1]
[1]*Optoelectronics Research Centre and School of Mathematics, University of Southampton, SO17 1BJ, UK*
[2] *Instituto de Optica - CSIC, Serrano 121, 28006 Madrid, Spain*

We demonstrate experimentally and theoretically that the Talbot effect on arrays of nano-holes may be used to achieve subwavelength localizations of optical and plasmonic fields.

OCIS codes: (350.5730) Resolution; (070.2580) Fourier optics.

In this paper we present a new way of achieving far-field subwavelngth focusing of light and plasmons using the Talbot effect. Some 170 years ago using periodic gold gratings and regular arrays of holes in a copper film, Talbot observed self-imaging of these structures at regular intervals when they were illuminated with point-like white light source. Here we demonstrate experimentally and theoretically that the Talbot effect on quasi-periodic arrays of nano-holes may be used to achieve subwavelength field localizations and well-isolated "hot spots" of high concentration of electromagnetic energy without evanescent filed components. We also demonstrate that a self-imaging effect exists for plasmon-polariton waves propagating at a metal-dielectric interface leading to focusing and localization of plasmons.