TRR 142
Tailored Nonlinear Photonics

TRR Guest Scientist Lecture / Seminar

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Towards plasmonic-enhanced tuneable second-harmonic-generation from isotropic non-centrosymmetric materials

Abstract:

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With current fabrication technologies we are now able to create devices of dimensions much smaller than the wavelength of light, opening a wide range of opportunities for new photonic devices. An example of this is the observation of extraordinary light transmission (EOT) through subwavelength apertures in a metallic film [1], now understood to be associated with the coupling of photons and Localized Surface Plasmons (LSPs) resulting in a strong electric field enhancement inside the apertures [2]. This effect has been exploited in metallic coaxial arrays filled with a non-centrosymmetric material for efficient second harmonic generation (SHG) without the need of phase-matching [3]. Furthermore, the resonant condition for EOT is very much dependent on the aperture geometry and polarization of light, demonstrated in periodic asymmetric cross apertures with a tuneable linear optical response [2,4,5]. In this work, we investigate the effect of light polarization in the SHG process from similar structures by integrating a non-centrosymmetric material.

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[1] Ebbesen, T. W.; Lezec, H. J.; Ghaemi, H. F.; Thio, T. and Wolff, P. A. “Extraordinary optical transmission through sub-wavelength hole arrays” Nature, 1998, 391, 667-669

[2] Roth, R. M.; Panoiu, N. C.; Adams, M. M.; Dadap, J. I. and Richard M. Osgood, J. “Polarization-tunable plasmon-enhanced extraordinary transmission through metallic films using asymmetric cruciform apertures” Opt. Lett., OSA, 2007, 32, 3414-3416

[3] Fan, W.; Zhang, S.; Panoiu, N.-C.; Abdenour, A.; Krishna, S.; Osgood, R. M.; Malloy, K. J. & Brueck, S. R. J. “Second Harmonic Generation from a Nanopatterned Isotropic Nonlinear Material” Nano Letters, 2006, 6, 1027-1030

[4] Thompson, P. G.; Biris, C. G.; Osley, E. J.; Gaathon, O.; Osgood, R. M.; Panoiu, N. C. and Warburton, P. A. “Polarization-induced tunability of localized surface plasmon resonances in arrays of sub-wavelength cruciform apertures” Opt. Express, OSA, 2011, 19, 25035-25047

[5] Osley, E. J.; Biris, C. G.; Thompson, P. G.; Jahromi, R. R. F.; Warburton, P. A. & Panoiu, N. C. Fano “Resonance Resulting from a Tunable Interaction between Molecular Vibrational Modes and a Double Continuum of a Plasmonic Metamolecule” Phys. Rev. Lett., American Physical Society, 2013, 110, 087402

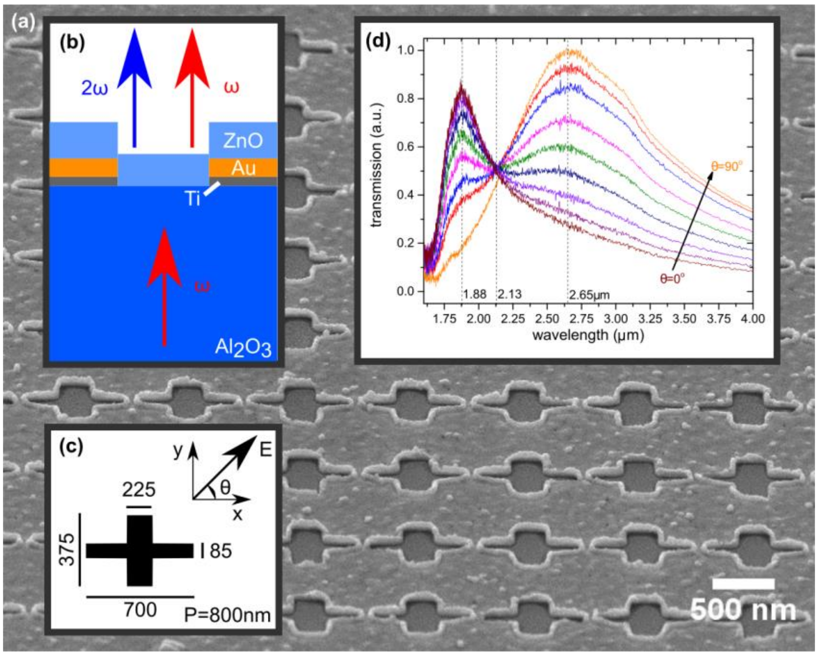

Figure 1 Array of asymmetric cross apertures in a thin metallic film covered with a non-centrosymmetric material, and with wavelength-polarization-dependent optical response. (a) Scanning-electron micrograph at 54o tilted angle of the array covered with a MBE growth ZnO film. (b) Schematic cross section of the device on a sapphire substrate with a 5nm titanium adhesion layer, 30nm gold film, and 75nm ZnO film. Strong electric field confinement within the aperture has potential in second-harmonic generation. (c) Aperture geometry showing the in-plane electric field polarization angle (θ), and relevant aperture dimensions in nanometers. Tuning of the resonant plasmonic modes is possible by scaling of the device. (d) Linear transmission optical response from the array measured using FTIR for different incident polarizations.

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