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Physics and applications of epsilon-near-zero materials

Monday 23 July 2018 14:00 (30 minutes)

This talk begins with a description of how the properties of light become modified for propagation through a material for which the dielectric permittivity epsilon is nearly vanishing. In such a situation, the refractive index also nearly vanishes, and thus both the wavelength of light and the phase velocity of light become nearly infinite. Radiative processes also are strongly modified, with both the Einstein A and B coefficients being dependent on the refractive index of the material. We have recently found that nonlinear optical properties tend to be strongly enhanced in epsilon-near-zero (ENZ) materials [1]. For the case of indium-tin-oxide (ITO), we measured a huge value (10^6 times larger than that of fused silica) of the nonlinear coefficient n_2. In subsequent work, we have fabricated a metasurface consisting of gold nanorods on an ITO substrate, and we have found that the nonlinear coefficient is further enhanced and can be controlled in both magnitude and sign [2]. The talk then turns to a discussion of the implications of the use of ENZ materials as a platform for applications in the field of nanophotonics.

1. Large optical nonlinearity of indium tin oxide in its epsilon-near-zero region, M. Z. Alam, I. D. Leon, and R. W. Boyd, Science 352, 795 (2016).
2. Large optical nonlinearity of nanoantennas coupled to an epsilon-near-zero material, M. Z. Alam, S. A. Schulz, J. Upham, I. De Leon and R. W. Boyd, Nature Photonics,12 79-83 (2018).

Poster contribution

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