Invited Talk

Coherent Information Processing on Metasurfaces at 40 Gbit/s and Beyond

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Coherent interaction of light with functional materials of substantially subwavelength thickness has given rise to the intriguing opportunity to turn any of the diverse optical functionalities that ultrathin films may provide "on" or "off" at will. Such dynamic control over the expression of thin film optical properties is possible as light-matter interactions in travelling light waves and standing light waves are very different. Optical standing waves formed by coherent, counterpropagating light waves have nodes and anti-nodes where either the electric field or the magnetic field vanishes, while the magnitude of the other is enhanced. A planar film or metasurface, which can only interact with the electric field of a normally incident plane wave, may thus be placed at an electric field node, where absence of electric field renders it perfectly transparent, or at an electric field anti-node, where its interaction with the wave will be enhanced due to the increased local electric field. Importantly, such high-contrast linear control of light with light occurs on a timescale of few femtoseconds and at arbitrarily low intensities down to single photons, implying 100 THz bandwidth, potential application in quantum technology and opportunities for energy-efficient signal processing with orders of magnitude higher bandwidth than current technology. We will give an overview over our recent breakthroughs enabled by coherent control of metasurface functionalities in areas such as coherent perfect absorption, all-optical signal modulation at 40 Gbit/s, electro-optical modulation, excitation selective spectroscopy, all-optical image processing and image analysis, control of polarization, propagation direction and focusing of light and more.