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Study of the angular momentum of light from plasmonic crystals

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In analogy to electron waves, electromagnetic waves also carry spin and orbital angular momentum (AM) and this property has been fascinating the world of optical science and engineering for many years. With the rise of nanotechnology, photonic systems can now be fabricated at the length scale of nanometers, manifesting many intriguing phenomena including the spin-orbit interaction in an observable extent. The polarization, the spatial field distribution, and the propagation direction are no longer treated separately and controlling one with another has become feasible. Plasmonic arrays are one of the most popular nanophotonic systems owing to their simplicity and well-defined structures for yielding controllable optical properties. They have been used in extraordinary transmission, fluorescence, photovoltaics, nonlinear optics, sensing, etc. In addition, since surface plasmon polaritons (SPPs) carry transverse spin AM, they should modify the AM of the outgoing radiation under the conservation of angular momentum. Unfortunately, this transverse spin is not properly taken into consideration even though plasmonic research has been carried out for years. Here, I will talk about the AM of light from plasmonic crystals. We have observed substantial polarization conversion and spin-orbital coupling from square lattice circular nanohole arrays, which do not possess intrinsic chirality. We find the transverse spin AM possessed by SPPs play a deterministic role in governing the far-field radiation. The experimental results are supported by finite-difference time-domain simulations and temporal coupled mode theory. Based on the AM study, we propose the AM can be used as a new parameter in surface plasmon resonance (SPR) sensing. As the transverse spin AM of SPPs is strongly dependent on the complex propagation wave vector, which is sensitive to the change of the local refractive index, the change in the AM of light thus reflects the sensing environment. The performance of the spin-SPR will be discussed.

Biography

H C Ong received his BA and PhD in Materials Science and Engineering from Northwestern University, USA. He currently is an Associate Professor in Physics Department, at the Chinese University of Hong Kong. He has been working on amorphous carbon, diamond, and ZnO for years and his current interest is light-matter interaction focusing on plasmonics. He has published more than 100 technical papers on fluorescence and sensing. He has been serving as an Organizer of international conferences.

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