Highlights

ACTIVITY E Advanced materials and techniques for organic electronics, biomedical and sensing applications - 2020

Electric Control of Spin-Orbit Coupling in Graphene-Based Nanostructures with Broken Rotational Symmetry

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Spin and orbital angular momenta of light are important degrees of freedom in nanophotonics which control light propagation, optical forces, and information encoding. Here, it is shown that graphene-supported plasmonic nanostructures with broken rotational symmetry provide a surprising spin to orbital angular momentum conversion, which can be continuously controlled by changing the electrochemical potential of graphene. Upon resonant illumination by a circularly polarized plane wave, a polygonal array of indium-tin-oxide nanoparticles on a graphene sheet generates the scattered field carrying electrically-tunable orbital angular momentum.

This unique photonic spin-orbit interaction occurs due to the coupling between graphene plasmon polaritons and localized surface plasmons of the nano-particles and leads to the controlled directional excitation of graphene plasmons. The tuneable spin-orbit conversion paves the way for high-rate information encoding in optical communications, electric steering functionalities in optical tweezers, and nanorouting of higher-dimensional entangled photon states.