ENZ Plasmonics

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In this talk, I will discuss the merging of two phenomena, the extreme-parameter metamaterials with the plasmonic optics. It is well known that the surface plasmon polaritons (SPP) in plasmonic structures possess apparent wavelengths along the metallic interfaces that are shorter than the free space wavelength. In the field of metamaterials, materials with extreme values for relative permittivities (or permeability), e.g., epsilon-near-zero (ENZ) materials exhibit refractive index being near zero, resulting in essentially uniform phase and very long apparent wavelengths in such media. We have been interested in exploring the merging of these two seemingly opposite features, by combining ENZ metamaterials with the SPP waves in plasmonic optics. We have been developing and exploring fundamental concepts and various potential applications of extreme-parameter plasmonic metamaterials. We have shown ENZ-based enhanced transmission through ultranarrow channels and bends with arbitrary shapes and forms, we have theoretically studied enhancement of molecular emission near ENZ-inspired plasmonic structures, and confinement of highly intense electric field in a channel. We have also investigated how ENZ materials manipulate the phase patterns of beams. In this talk, I will give an overview of this ENZ-based plasmonics, and will discuss exciting potentials and future ideas and possibilities.