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Metaplasmonics and Epsilon-Near-Zero Metamaterials for Optical Nanocircuits, Wave-Bending Tunneling Elements, and Nanoantennas NADER ENGHETA, ANDREA ALU, MARIO SILVEIRINHA, BRIAN EDWARDS, MICHAEL YOUNG, JINGJING LI, University of Pennsylvania — Negative-permittivity plasmonic media, engineered epsilon-near-zero (ENZ) metamaterials, and zero-index materials may be exploited as building blocks for synthesis of more complex metamaterials and structures. We have been exploring fundamental concepts and various potential applications of plasmonic materials and ENZ metamaterials, and have studied several metaplasmonic-based structures, devices, and nanocircuits. Among these: (1) we will discuss some of the processing features of meta-nanocircuits, in which the arrangement of plasmonic and nonplasmonic nanostructures may provide the functionalities of optical circuits capable of tailoring electric fields within subwavelength regions and loading and tuning optical nanoantennas; (2) we will present theoretical and experimental results on ENZ-based supercoupling and wave-bending tunneling phenomena in waveguides with ultranarrow subwavelength channels and bends; and (3) we will mention our designs and analyses of optical nanoantennas and arrays inspired from microwave antennas. Future directions in these areas will also be forecasted.

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