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Optics with Metals: Novel and Future Developments

JOSEPH W. HAUS, University of Dayton

Nanofabrication tools have long ago leapt the hurdle to single atom manipulation and material deposition control at a sub-nanometer scale; todays nanophotonics devices are routinely fabricated using material engineering to exploit quantum mechanical effects. Recent developments in metallic materials structured with nanometer scale features have spawned the field of nanoplasmonics; the word plasmon conjures up applications of free electron dynamics that are important in both electronic and photonic applications. Nanoplasmonic structures can be designed to concentrate electromagnetic intensity leading to scattering effects that are magnified by eight to twelve orders of magnitude. With new understanding of concentrating electromagnetic fields researchers have proposed new device designs with improved performance including molecular sensors, efficient energy harvesters and novel light sources. Incorporating quantum tunneling into the nanoplasmonic systems has only recently been done. Ultimately it is the quantum tunneling effect that will determine the optimal designs of new devices and sensors with nanoplasmonic materials.