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Theory and modeling of light interactions with metallic nanostructures[1]

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Metallic nanostructures such as systems containing metal nanoparticles or metal films with nanoscale diameter holes or other nanostructured features are intriguing systems. Surface plasmons, special electronic excitations near the metallic surfaces, can then be excited with visible light. In addition to interest in their fundamental behavior and interactions, surface plasmons are useful in a variety of practical areas, including chemical and biological sensing and optoelectronics. Surface plasmons can be intense and localized, and correctly describing their behavior in complex systems can require numerically rigorous modeling techniques. This talk presents a discussion of the results of rigorous electrodynamics modeling using the finite-difference time-domain (FDTD) method. Such calculations may be used to validate ideas and concepts based on approximate models. Detailed inspection and analysis of the results can also lead to the development of new physical pictures . In particular, FDTD calculations are used to show (i) how it is possible to increase the propagation lengths surface plasmon polaritons with the use of appropriate dielectric underlayers, (ii) how to efficiently bend light in a subwavelength region, and, (iii) how nanoholes and wells in metal films can exhibit complex transmission spectra of relevance to sensing.

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