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Plasmolecular Electronics and Photonics

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Metallic nanostructures have received considerable attention for their ability to manipulate light at the nanoscale. Near-field optical measurements and electromagnetic simulations are presented that highlight the limitations and capabilities of such structures to guide, concentrate, and modulate surface plasmon-polaritons (SPPs). Systematic studies on (passive) metallic stripe waveguides are presented that demonstrate that the propagation of electromagnetic energy is mediated by a discrete number of guided SPP modes as well as a continuum of radiation modes. Using a parametric study of the propagation length as a function of stripe width and multimode interference studies, we will also show modal cutoff in narrow stripes. We then continue to show how the unique properties of SPPs and optically or electrically active molecules can be exploited to open up a new area of research: plasmolecular electronics and photonics. Several devices will be discussed that are based on nanoscale metal-molecule-metal junctions with optically active molecules developed for non-linear optics applications, such as spiropyrans and azobenzenes. In these junctions one can control the flow of electrons based on plasmonic signals or control the flow of surface plasmons based on an electronic signals. The implication of these results on the design of future plasmonic components will be discussed, as well as the potential synergy with electronic and photonic device technologies.