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Sub-wavelength confinement and the diffraction limit for surface plasmon waveguides RASHID ZIA, ANU CHANDRAN, MARK SELKER, MARK BRONGERSMA, Stanford University — Surface plasmon-polaritons have received much attention for their ability to guide electromagnetic energy at optical frequencies. Unlike dielectric waveguides which confine volume electromagnetic waves to an optically dense core via index contrast, these surface electromagnetic waves are coupled to localized charge density oscillations along metal-dielectric interfaces. Consequently, theoretical and experimental works to date have highlighted the differences between the confinement provided by dielectric and plasmonic waveguides. Here, we present a series of related computational and experimental studies directed at illustrating the similarities of dielectric and plasmonic waveguides. Beginning with near-field images of confined plasmon propagation obtained by Photon Scanning Tunneling Microscopy (PSTM), we will discuss the limitations on confinement in plasmonic waveguides. These images will be interpreted by comparison with three-dimensional numerical solutions for the guided polariton modes. Vertical and lateral localization along finite width interfaces will be contrasted, and power density profiles investigated. The implications for the diffraction limited size of surface plasmon modes will be discussed, and ideal geometries for power concentration highlighted.

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