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Plasmon Polariton Modes in High Index Dielectric Structures
KYLE HOKE, KODIAK MURPHY, BRAD JOHNSON, JANELLE LEGER, Western Washington Univ — The need to interface optical signals with increasingly small electronic components has led to an interest in subwavelength waveguides. Surface plasmon polaritons (SPPs) are longitudinal surface charge density oscillations localized to a metal/dielectric interface, and as such are capable of confining energy in a structure which is not diffraction limited. Waveguides based on the excitation of SPPs are promising for short-range applications, but in these structures Ohmic damping significantly limits propagation length due to the bulk of the electric field propagating along a metal interface. Here we demonstrate that through selection of materials with specific optical properties, Ohmic damping can be drastically reduced. Specifically, high index dielectric plasmon polariton modes (HID-PPMs) are surface-constructed waves that exist in structures having a core dielectric layer with a higher refractive index than the substrate supporting them. Modes in this region exhibit oscillatory electric fields with the bulk of their electric field confined in the dielectric layer, similar to a total internal reflection waveguide. Damping and insertion losses may therefore be drastically reduced in such structures. Here we report the demonstrationof HID-PPMs in Au/TiO2/Au MIM devices using attenuated total reflectance measurements. Characterization of these modes was performed for several devices of differing core dielectric thickness. Results are in good agreement with theory. We will discuss the application of these waveguides to several technologies related to solar energy conversion.

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