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Ultra-low Damping of Surface Plasmon Polaritons in Atomically Smooth Epitaxial Ag Films: An Extraordinary Optical Transmission Study CHARLOTTE E. SANDERS, UT Austin, B.H. LI, Chinese Academy of Sciences, Institute of Physics, Beijing, JAMES MCILHARGEY, S. HOSSEIN MOUSAVI, ALEXANDER B. KHANIKAEV, UT Austin, X.G. QIU, Chinese Academy of Sciences, Institute of Physics, Beijing, GENNADY SHVETS, C.K. SHIH, UT Austin — When an electro-magnetic radiation field couples strongly to surface plasmons, a surface plasmon polariton (SPP) is formed. In recent years, studies of SPPs in metal films perforated with hole lattices have revealed broad technological implications ranging from exotic metamaterials for sub-wavelength resolution microscopy to ultra-compact plasmonic waveguides for optical interconnects, as well as many other exciting technological applications. Thus far, most investigations have employed dielectric/metal hybrid structures with granular polycrystalline metal films. Although many conceptual devices have been demonstrated, one factor significantly limits their technological potential: the strong damping of SPP propagation. By using atomically smooth, epitaxial Ag films we show that such a damping effect can be mostly eliminated, resulting in nearly ideal extraordinary optical transmission (EOT) through sub-wavelength hole arrays in the mid-infrared range. This also allows us to map out very detailed SPP band structure, with analogy to the electronic band structure in solids.

Charlotte E. Sanders
UT Austin

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