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One Dimensional Surface Phonon Polaritons in Boron Nitride Nanotubes: High Field Confinement and Localization[1] XIAOJI XU, Lehigh University, Bethlehem, PA, USA, BEHNOOD GHAMSARI, University of Ottawa, Ottawa, Ontario, Canada, DMITRI GOLBERG, WPI-MANA Centre of National Institute for Materials Science, Tsukuba, Ibaraki, Japan, PIERRE BERINI, University of Ottawa, Ottawa, Ontario, Canada, GILBERT WALKER, University of Toronto, Toronto, Ontario, Canada — We report the direct observation of one dimensional surface phonon polaritons (SPhPs) in boron nitride (BN) nanotubes at the mid infrared frequencies. High spatial resolution infrared near-field microscopy is used to spatially map the distribution of SPhPs in BN nanotubes. The polaritonic wavelength is experimentally found to be tuneable by the tubular diameter as well as the configurations of the conductive supporting substrate. Effective refractive index of the SPhPs is found to be as high as ~ 70 for a thin BN nanotube. Furthermore, strong field localization and mitigation of the polariton damping is achieved with the use of a rough gold substrate. The randomly spaced nanometer-sized gold grains on the substrate act as distributed reflectors for propagating SPhPs, and confined the surface waves in the one-dimension nanotube. Such geometry allows high field concentration at mid infrared frequencies for chemical sensing and nonlinear optics. Given the analogy between phonon polaritons and plasmon polaritons, BN nanotubes can be used for building blocks for nano-photonics devices in the mid infrared frequencies, with design principles learnt from well-established metallic plasmonics.

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