

Excitation and Active Control of Charge Density Waves at Degenerately Doped PN++ Junctions

Authors : R. K. Vinnakota, D. A. Genov, Z. Dong, A. F. Briggs, L. Nordin, S. R. Bank, D. Wasserman

Abstract : We present a semiconductor-based plasmonic electro-optic modulator based on excitation and active control of surface plasmon polaritons (SPPs) at the interface of degenerately doped $\text{In}_{0.53}\text{Ga}_{0.47}\text{As}$ pn++ junctions. Set of devices, which we refer to as a surface plasmon polariton diode (SPPD), are fabricated and characterized electrically and optically. Optical characterization predicts far-field voltage-aided reflectivity modulation for mid-IR wavelengths. Numerical device characterizations using a self-consistent electro-optic multiphysics model have been performed to confirm the experimental findings were predicting data rates up to 1Gbits/s and 3dB bandwidth as high as 2GHz. Our findings also show that decreasing the device dimensions can potentially lead to data rates of more than 50Gbits/s, thus potentially providing a pathway toward fast all-semiconductor-based plasmotronic devices.

Keywords : plasmonics, optoelectronics, PN junctions, surface plasmon polaritons

Conference Title : ICNOP 2022 : International Conference on Nanotechnology, Optoelectronics and Photonics

Conference Location : Tokyo, Japan

Conference Dates : November 10-11, 2022