Metal-Doped Semiconductor Plasmonic Optoelectronic Switch

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Abstract

This research introduces an electro-optic modulator based on a Metal-Semiconductor (M-S) junction, aimed at advancing functional plasmonic circuits through active control of surface plasmon polaritons (SPPs) at the interfaces of M-S devices. To evaluate the device's performance, we performed extensive self-consistent multi-physics simulations on COMSOL Software, which included analyses of electromagnetic, thermal, and current-voltage (IV) characteristics, focusing on Germanium (Ge) based Schottky contacts. These simulations were crucial for estimating the modulation of SPPs under different bias conditions and determining the switching times. Our goal was to improve both optical confinement and operational speed. The numerical simulations revealed that the device demonstrates exceptional capabilities, achieving signal modulation beyond -50dB, responsivity over -100dB/V, and switching rates reaching up to 100GHz. These findings suggest significant potential for utilizing Schottky junctions as active components in the design of plasmonic-based integrated circuits.

Figures used in the abstract

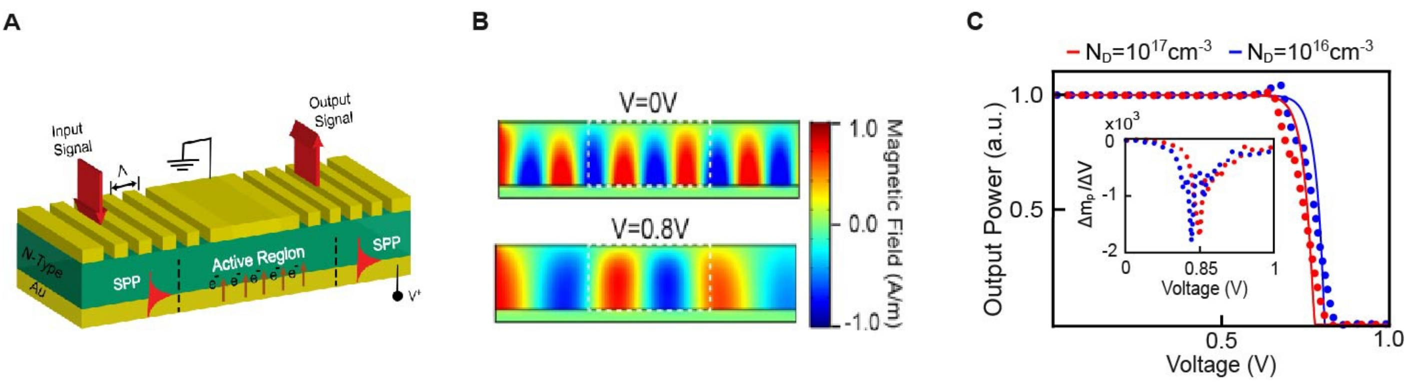

Figure 1 : (a) Schematic of SSPD (b) Magnetic field density at zero voltage and critical voltage (c) Transmittance of the device under different doping concentrations