'Switchable grating' enables ultracompact, broadband, and ultrahigh modulation-depth plasmonic switch

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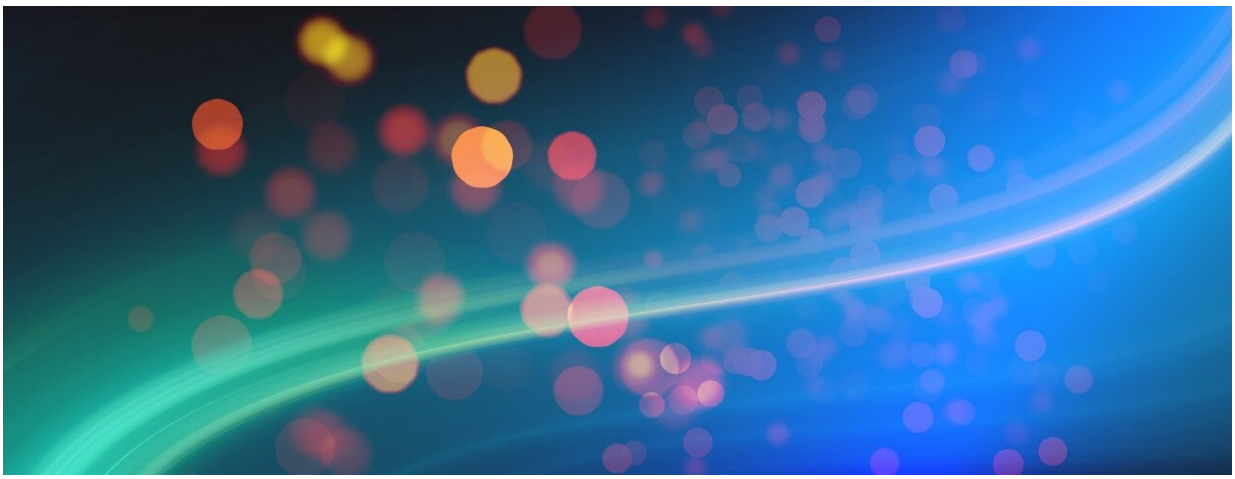

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In order to integrate logic gates and communicate over short distances optically, plasmonic interconnections are essential components of optical interconnection schemes. Therefore, switching has attracted much attention.

In a study published in *Plasmonics*, Sandeep Chamoli from Changchun Institute of Optics, Fine Mechanics and Physics of the Chinese Academy of Sciences, collaborating with Mahommad Elkabash from

Massachusetts Institute of Technology, U.S., and Guo Chunglei from University of Rochester, U.S., presented a novel and universal scheme for compact and high modulation-depth (MD) optical and plasmonic switches. They numerically demonstrated surface plasmon (SP) and bulk plasmon (BP) based switches with a low footprint, high MD and low insertion losses.

Conventional plasmonic switching approaches rely on modifying the dispersion of the surface plasmon polariton (SPP) wave at the metal/dielectric interface.

In this study, the researchers used a switchable grating that switches the excitation of plasmonic/optical modes. This switchable grating is based on a low loss phase change material Sb_2S_3 embedded in a dielectric environment with a refractive index close to that of Sb_2S_3 amorphous phase. The grating effectively disappears when Sb_2S_3 is in its amorphous phase.

Based on the same "switchable grating" principle, a new type of plasmonic switch was demonstrated using bulk plasmon polariton (BPP) excited inside hyperbolic metamaterials (HMMs), and its performance was compared with the SPP-based switch.

Finally, the researchers demonstrated a new platform for non-local control of the local density of optical states and coupled output power of quantum emitters embedded in HMMs.

"This novel approach is universal and provides low footprint and high MD optical and plasmonic switching," said Chamoli.

More information: Sandeep Kumar Chamoli et al, Switchable Gratings for Ultracompact and Ultrahigh Modulation Depth Plasmonic Switches, *Plasmonics* (2022). DOI: 10.1007/s11468-022-01602-1