Propagating Plexcitons in 2D Semiconductors Launched by Surface Acoustic Waves

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In this work, we theoretically demonstrate the strong coupling between excitons in 2D semiconductors and surface plasmons in a thin metal film forming exciton-plasmon polaritons (or plexcitons)that can be optically accessed by means of a surface acoustic wave (SAW). The strain field of the SAW creates a dynamic diffraction grating, providing the momentum match for the surface plasmons, whereas the piezoelectric field that could dissociate the excitons is cancelled out by the metal. This is exemplified for monolayer MoS_2 and mono- and few-layer black phosphorus on top of a thin silver layer on a $LiNbO_3$ piezoelectric substrate, providing Rabi splitting of 100-150 meV [1]. Thus, we demonstrate that SAWs are powerful tools to modulate the optical properties of supported 2D semiconductors by means of the high-frequency localized deformations tailored by the acoustic transducers, that can serve as electrically switchable launchers of propagating plexcitons suitable for active high-speed nanophotonic applications.

References

[1] R. Fandan, J. Pedrós, and F. Calle, *ACS Photonics*, 8(6) (2021) 1698

Figures

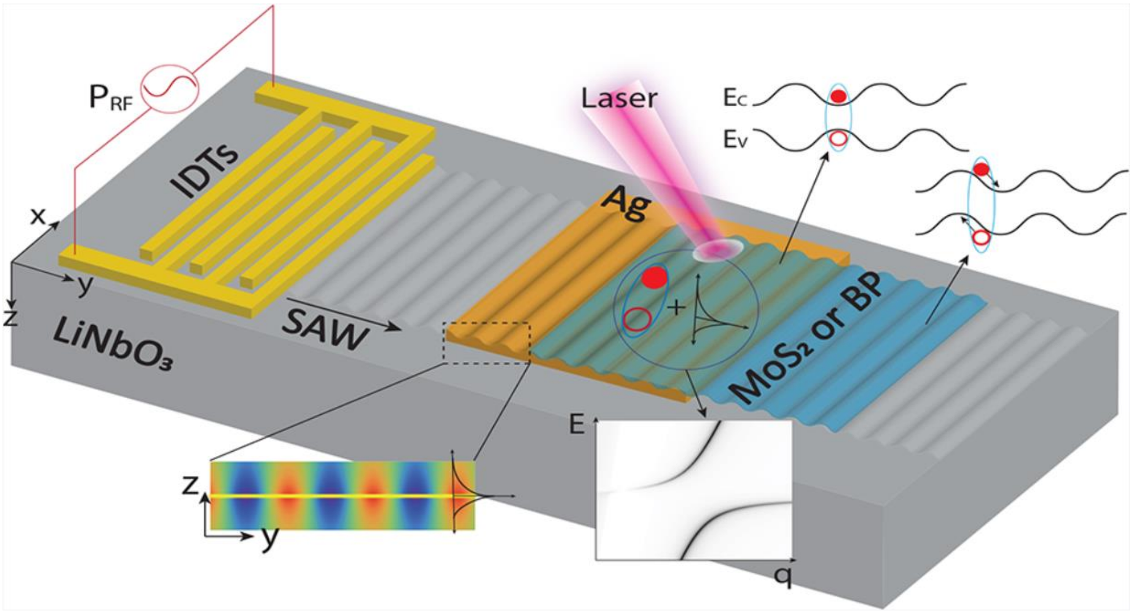

Figure 1: Schematic of the proposed plexciton launcher where a SAW generated by interdigitated transducers (IDTs) placed on top of a piezoelectric substrate leads to the coupling between metal plasmons and excitons in 2D semiconductors by means of the dynamic surface rippling and bandgap modulation.