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Surface Plasmon Polariton-Assisted Long-Range Exciton Transport in Monolayer Semiconductor Lateral Heterostructure JINWEI SHI, Beijing Normal University, MENG-HSIEN LIN, YI-TONG CHEN, National Tsing-Hua University, NASIM MOHAMMADI ESTAKHRI, The University of Texas at Austin, GUO-WEI TSENG, National Tsing-Hua University, YANRONG WANG, Beijing Normal University, HUNG-YING CHEN, CHUN-AN CHEN, National Tsing-Hua University, CHIH-KANG SHIH, ANDREA AL, XIAOQIN LI, The University of Texas at Austin, YI-HSIEN LEE, SHANGJR GWO, National Tsing-Hua University — Recently, two-dimensional (2D) semiconductor heterostructures, i.e., atomically thin lateral heterostructures (LHSs) based on transition metal dichalcogenides (TMDs) have been demonstrated. In an optically excited LHS, exciton transport is typically limited to a rather short spatial range (˜1 micron). Furthermore, additional losses may occur at the lateral interfacial regions. Here, to overcome these challenges, we experimentally implement a planar metal–oxide–semiconductor (MOS) structure by placing a monolayer of WS2/MoS2 LHS on top of an Al2O3 capped Ag single-crystalline plate. We found that the exciton transport range can be extended to tens of microns. The process of long-range exciton transport in the MOS structure is confirmed to be mediated by an exciton–surface plasmon polariton–exciton conversion mechanism, which allows a cascaded energy transfer process. Thus, the planar MOS structure provides a platform seamlessly combining 2D light-emitting materials with plasmonic planar waveguides, offering great potential for developing integrated photonic/plasmonic functionalities.

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