Long-range propagation of exciton-polaritons in large-area 2D semiconductor monolayers

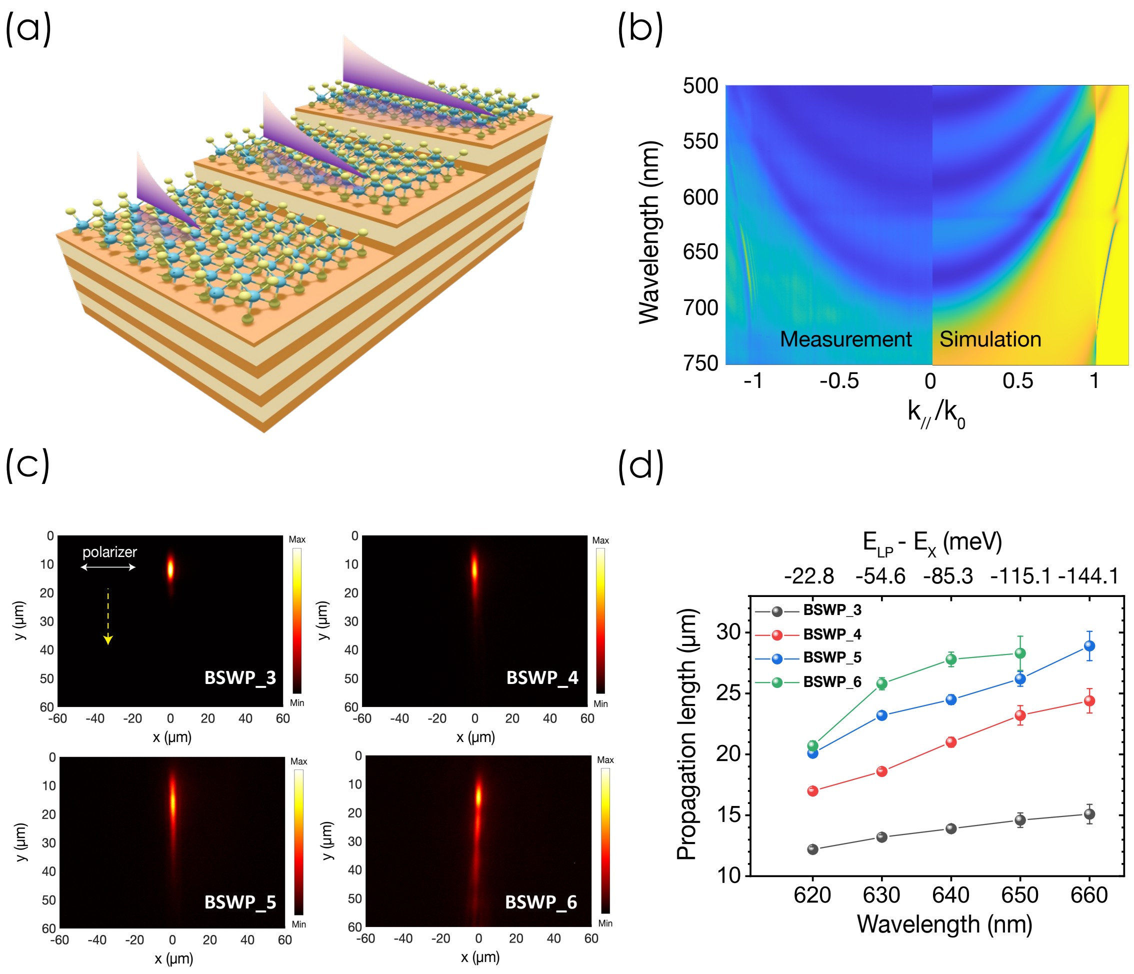

Figure: (a) Schematic of polariton systems comprising WS_2 monolayers and distributed Bragg reflectors (DBR). (b) Measured and simulated angular reflectivity spectra of a polariton structure (BSWP-5). (c) Structure-dependent polariton propagation. (d) Comparison of wavelength-dependent propagation lengths for different samples.

Objective

➢ To achieve and manipulate long-range energy transport by exciton-polaritons in large-area atomically thin transition metal dichalcogenides (TMDs)

Impact

Long-range transport in TMDs is challenging due to the lack of availability of large area films. in this work we demonstrate metal-organic chemical vapor deposition grown centimeter-scale monolayers of WS_2 that support polariton propagation lengths of up to 60 μm. The polaritons form through the strong coupling of excitons with Bloch surface waves (BSWs) supported by all-dielectric photonic structures. We observe that the propagation length increases with the number of dielectric pairs due to the increased quality factor of the supporting distributed Bragg reflector. Furthermore, a longer propagation length is observed as the guided, or BSW content of the polariton is increased. Our results provide a practical approach for the systematic engineering of long-range energy transport mediated by exciton-polaritons in TMD layers.

Facilities and Methods Used

- Plasma Enhanced Chemical Vapor Deposition
- Fourier-Plane Imaging Microscopy

Funding

- US Army Research Office
- Universal Display Corporation

Contact

- Bin Liu, binliuqi@umich.edu

Optoelectronic Components and Materials Group

OCM