

High-performance Polymer Photonic Devices for Chip-scale Optical Interconnects

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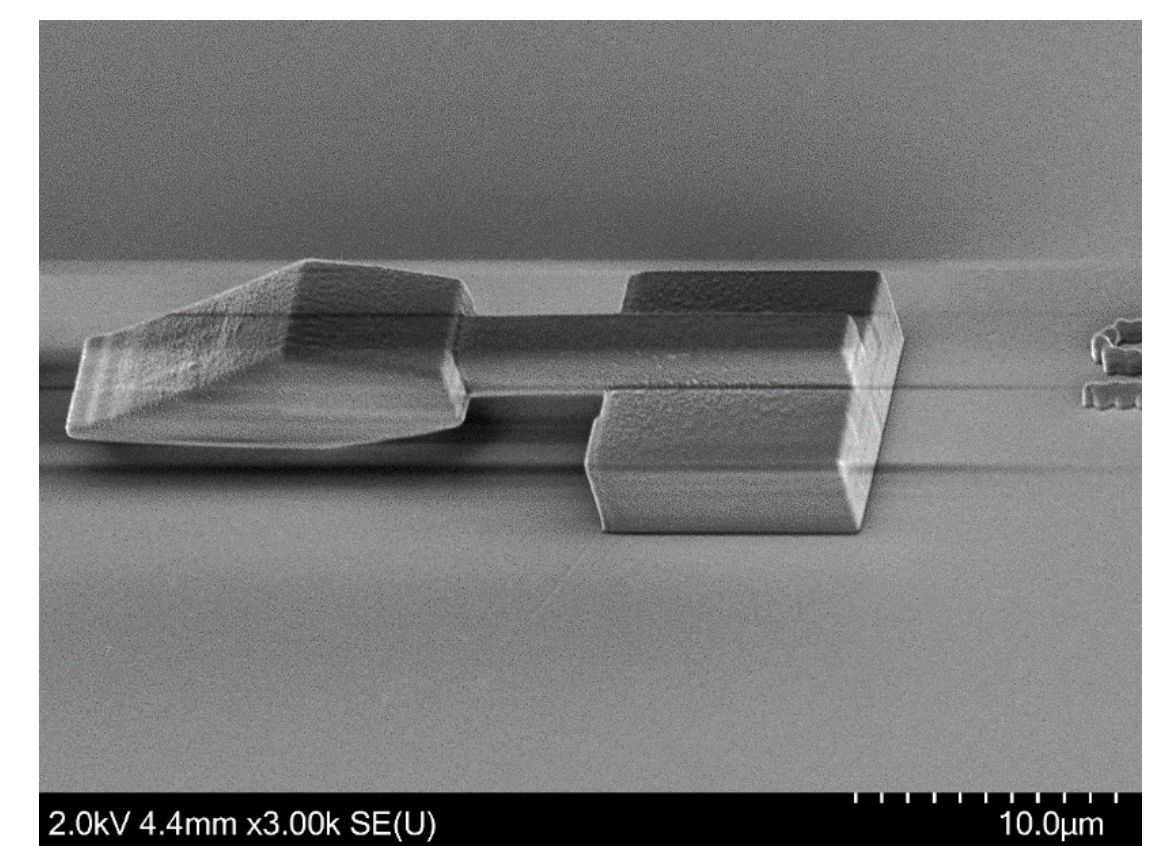
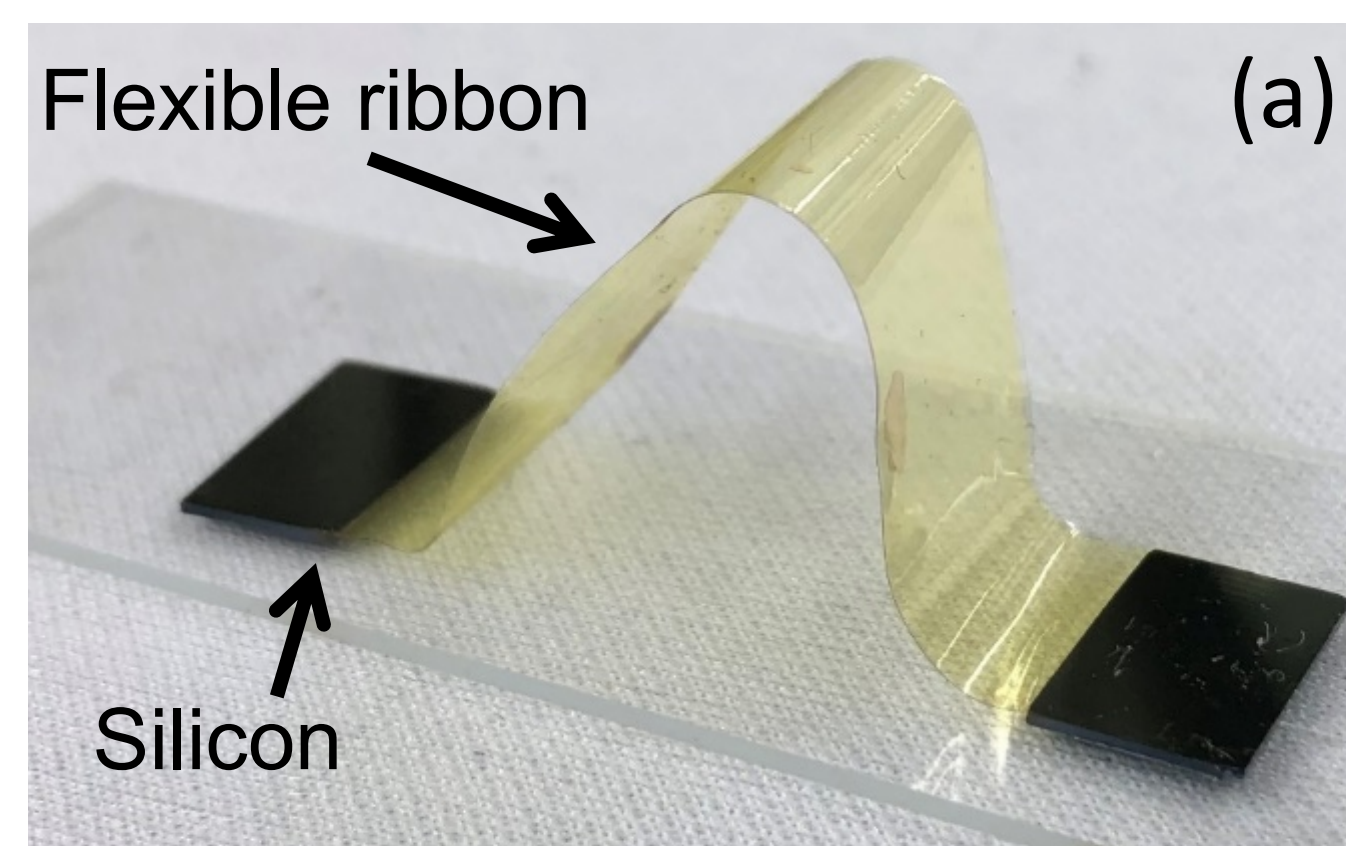
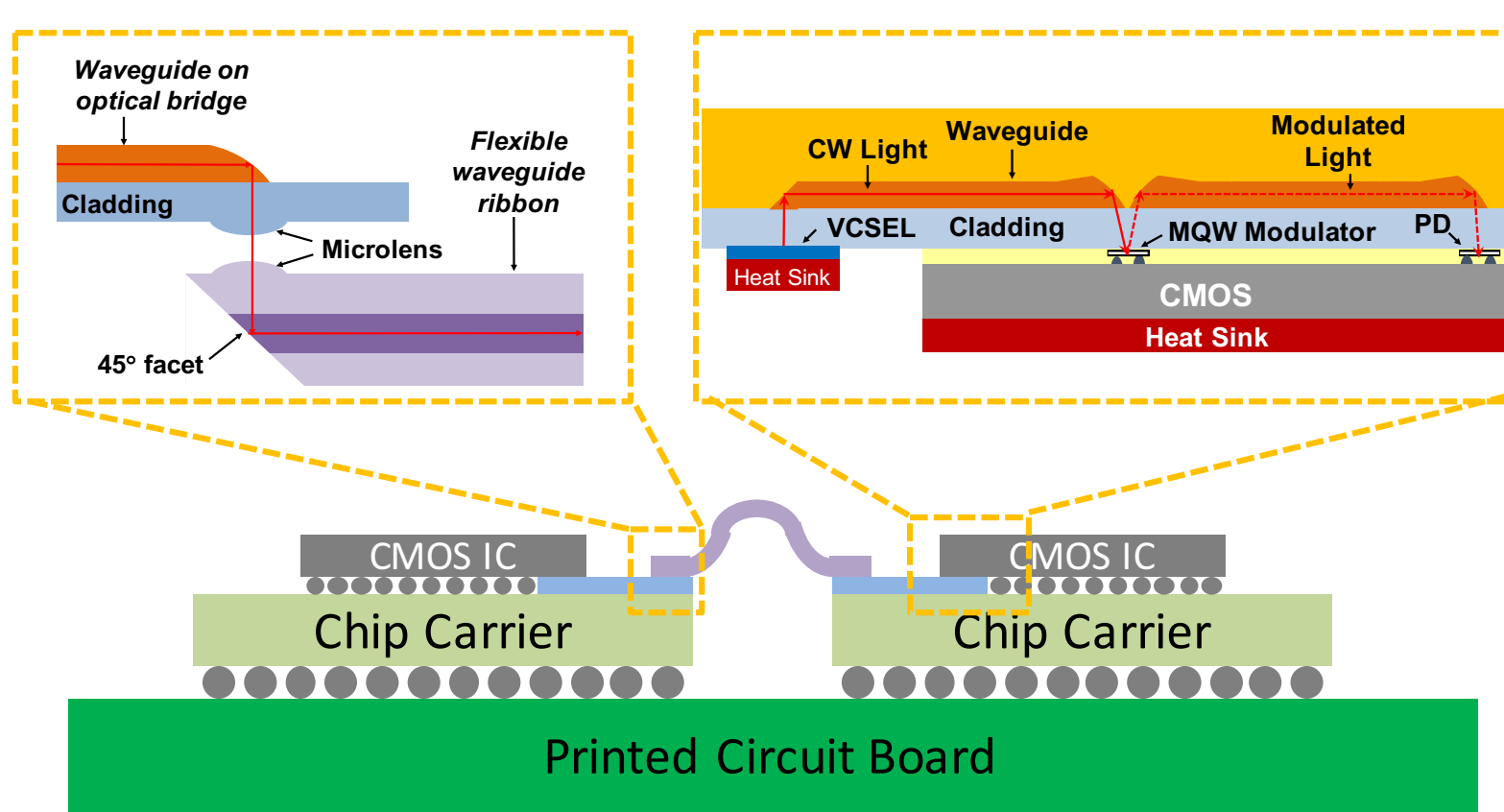
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Introduction

- Large-scale data centers and high-performance computers are becoming increasingly limited by the capacity of interconnects on energy efficiency, bandwidth density, etc.
- Optical interconnects have been deployed at ever-decreasing communication distances while significant challenges exist at the board- and chip-levels.
- Key metrics include link power consumption, bandwidth density, packaging, scalability, and costs.

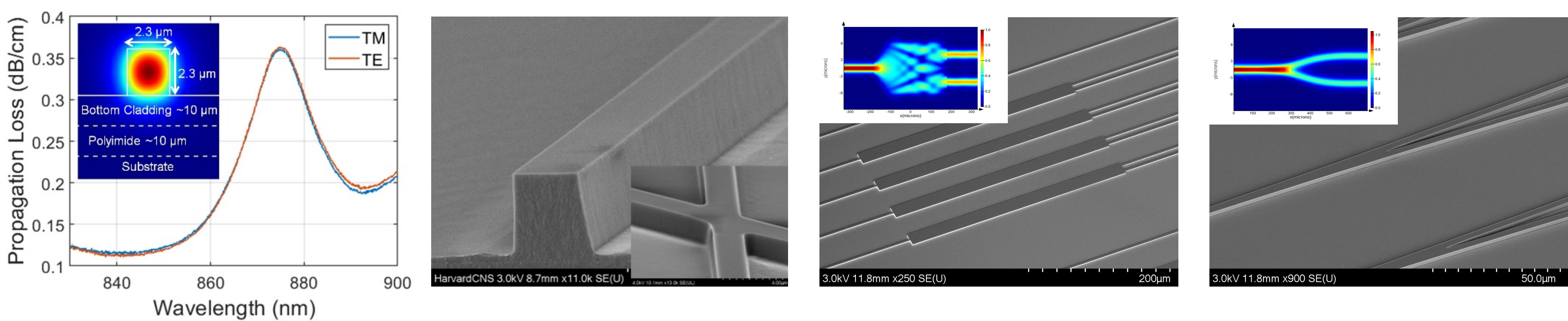
Approach

- Novel integrated “optical bridge” platform interfacing between Si-CMOS and flexible ribbon single-mode polymer waveguide network
- Low-loss, dense polymer waveguides coupled with VCSEL, modulators, or PDs.
 - Energy-efficient surface-plasmon enhanced MQW modulator
 - Si photonic devices
 - Bandwidth density > 100 Tbps/cm²
- New free-form micro-optical couplers with superior efficiency and tolerance
- Compatibility with standard pick-and-place assembly and passive alignment



Single-mode polymer waveguide devices

- Device fabrication using standard UV lithography
- Low loss single mode waveguides: 0.12 dB/cm @ 850 nm, polarization insensitive
- Highly flexible: negligible degradation after 1,000 bending cycles @ 2 mm radius
- Demonstrate a variety of efficient polymer photonic devices, e.g., MMI, Y-branches



Novel free-form photonic coupling platform for dense optical I/Os

- Direct 3D lithography on photoresist (SU8, OrmoComp, etc.)
- Universal 3D coupling between waveguides, fibers, and surface-normal devices
- High efficiency: < 0.3 dB IL (inter-layer waveguides and waveguide-to-fiber coupling)
- Broadband: > 400 nm spectral bandwidth covering all long-wave telecom bands
- High channel density: areal interfacing to 2D fiber arrays

