Suspended Optical Waveguides in InP for Optomechanical Applications

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Optical micro-electromechanical systems (MEMS) based on suspended optical waveguides offer a range of interesting applications, e.g. in optical communications and sensing. In particular, if the waveguide dimensions are sufficiently small and thus the evanescent field of propagating light extends beyond the guiding material into air, two closely spaced parallel waveguides become optically coupled with a coupling strength that is strongly dependent on the waveguide separation. This effect can be exploited for mechanically actuated optical switching, tuning of micro-resonators, or even for changing the speed of light [1].

Here we present the design and fabrication of sub-micron sized suspended waveguides in indium phosphide [2], optimized to act as a continuously tunable optical buffer. Compared to the silicon platform, III-V materials offer the advantage of a direct bandgap and thus the potential for incorporating optical gain to compensate for waveguide losses directly on the same chip. A major challenge of such a design is to minimize waveguide losses at the supporting contact points that hold the waveguides. Our finite-element simulations suggest that adiabatic, S-shaped connectors provide the best performance, Fig. 1(a,b). If two waveguides are initially separated by ~100 nm, we expect tunability of the propagation velocity of light by a factor of two using electrostatic actuation voltages of just 3 V.

We have fabricated first sample structures in InP/InGaP using an InGaAs sacrificial layer and a combination of dry and wet etching and supercritical drying. The resulting structure, Fig. 1(c), has waveguide dimensions of 300 nm (height), 200 nm (width) and a waveguide separation of 400 nm. Preliminary investigations under a scanning electron microscope (SEM) have demonstrated the movability of the waveguides.

This talk will discuss our designs and simulations to optimize optical and mechanical performance, and will review the progress on fabrication and characterization.

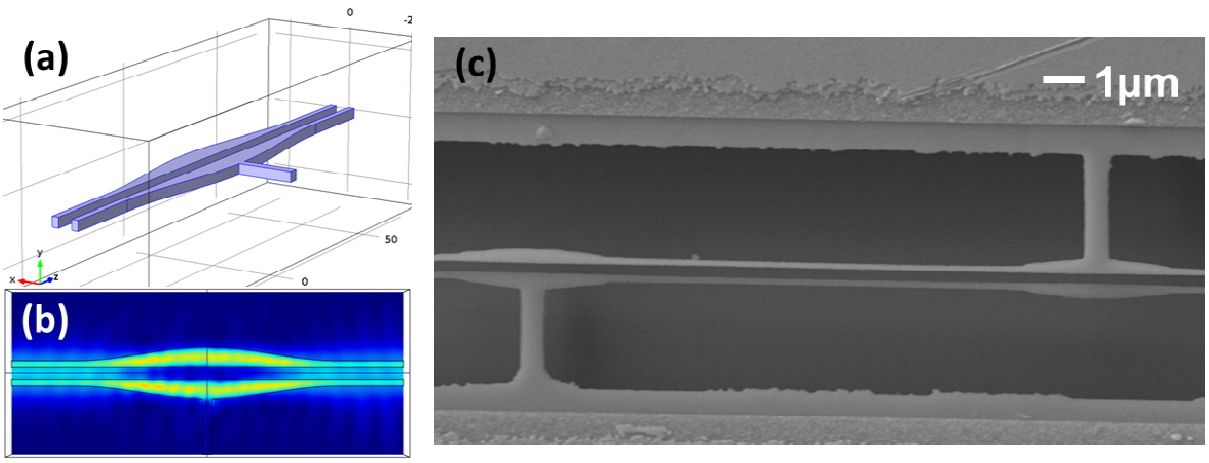

Fig1. (a) Design of S-shaped support structure for air-suspended sub-micron InP waveguides. (b) Simulated light propagation showing minimum scattering losses. (c) SEM image of fabricated waveguides and supports.

1. P. Horak, W. Stewart, and W. H. Loh, *Opt. Express* **19**, 12456 (2011).
2. W. H. Ng, N. Podoliak, P. Horak, H. Liu, J. Wu, W. J. Stewart, and A. J. Kenyon, *IEEE J. Sel. Top. Quantum Electron.* **21**, 4400107 (2015).

Presentation Method (Invited/Regular Oral/Poster): Invited