Flexible Optical Neural Probes for High Resolution Neural Stimulation

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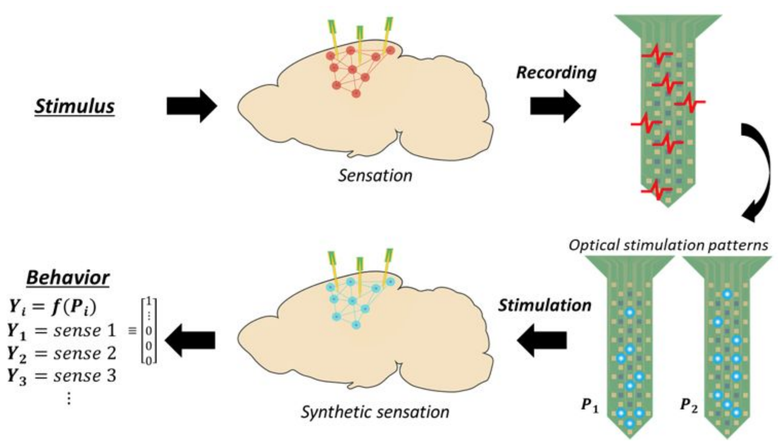
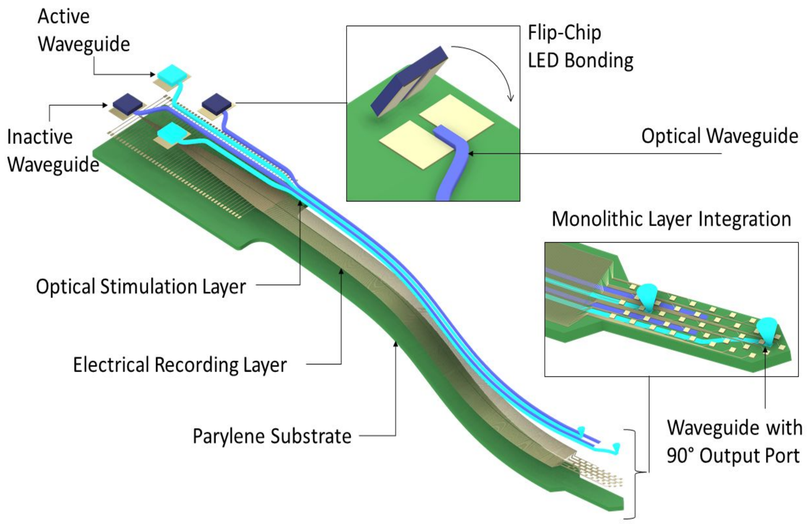
Motivation



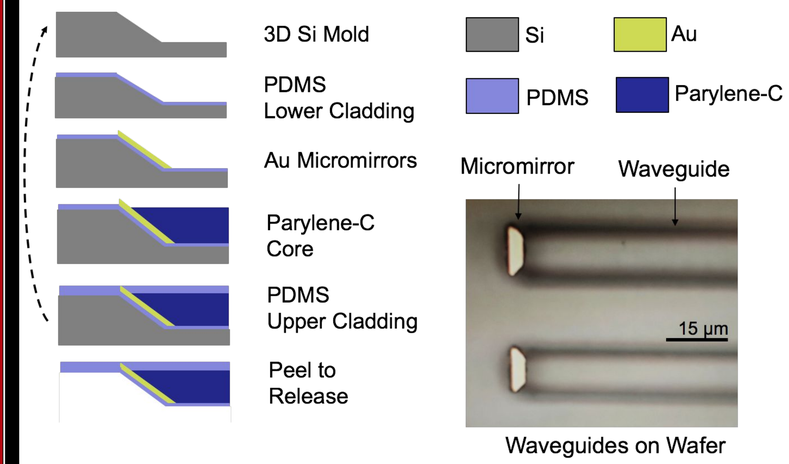
High resolution barin-computer interfaces (BCIs) must:
- enable simultaneous neuronal R/W control across multiple brain regions
- be biostable/biocompatible
- be compact and flexible to avoid damage to neural tissue

Parylene Waveguide Neural Probes



Our high-density implantable optoelectrical neural interfaces:
- are made in biocompatible, flexible substrates
- able to simultaneously record and stimulate localized neural populations

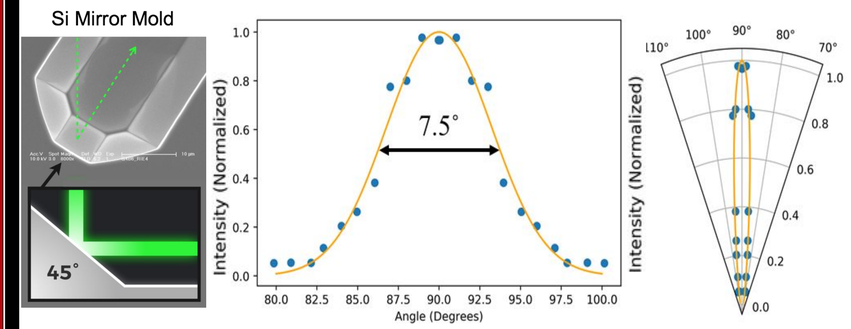
Waveguide Microfabrication Process



Waveguides on Wafer

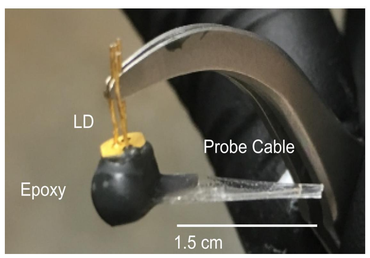
45° micro-mirrors are patterned in Silicon and transferred to conformally deposited polymer layers to maintain shape using the principles of nanoimprint lithography.

Micro-Mirrors for 90-Degree Input/Output

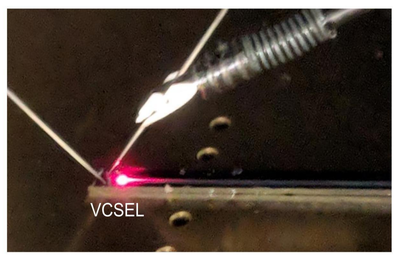


Light incident on the mirror will be redirected 90-degrees for out of plane input coupling/output illumination. Output profile has a narrow beam divergence - 7.5 degrees - suitable for localized stimulation

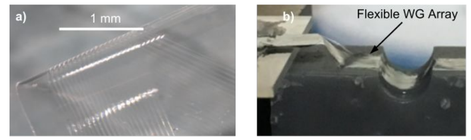
Laser Diode Packaging (3 mm)

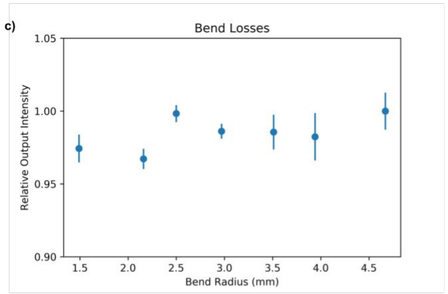


VCSEL Chip Packaging (200 µm)



Flexibility and Bend Loss

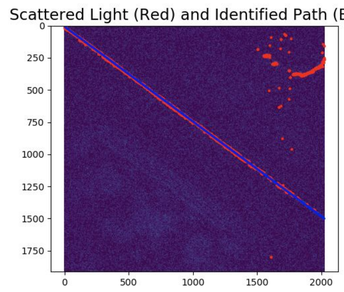


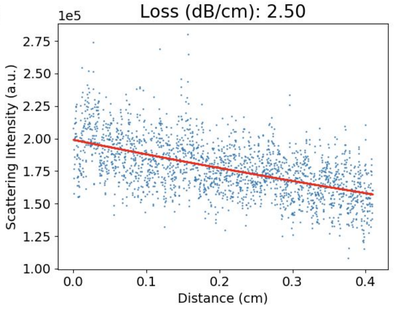


Released probes are extremely flexible.

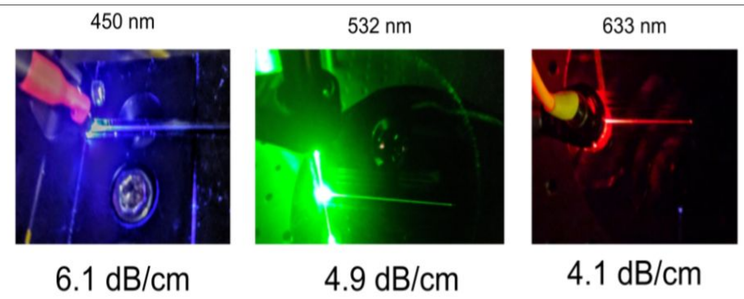
Bend losses are characterized to be minimal for milli-scale bends, which may occur due to routing during implantation.

Propagation Loss Characterization





- Propagation loss is calculated from the light intensity profile.
- Broadband operation across the range of optogenetics.



In-Vitro Characterization

Brain Slice Stimulation