High-Density Optical Neural Probes

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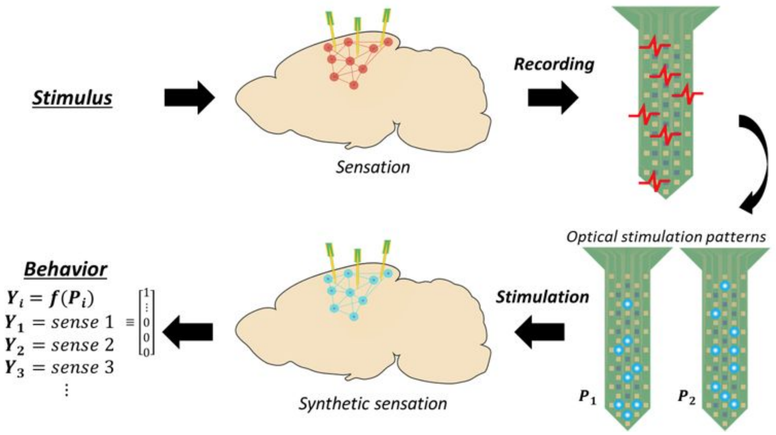
Brain Computer Interfaces:



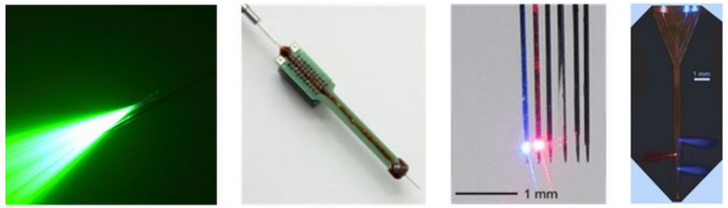
Could human perception be manipulated and augmented? Could we alter or edit memory?

Understanding the mechanisms of brain function will inform the design of the next generation of brain-machine interfaces.

Developments in BCI:

Towards higher resolution

Fiber Optics | **Microfabrication**

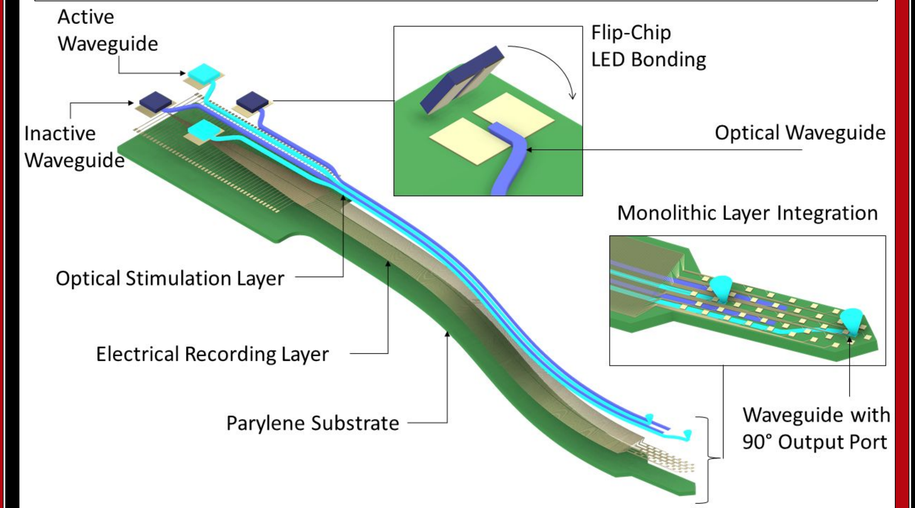


Neuronexus (200 µm fiber) | Buzsaki lab | Boyden Lab

High resolution BCIs must:

- enable simultaneous neuronal R/W control across multiple brain regions
- be biostable/biocompatible
- be compact and flexible to avoid damage to neural tissues

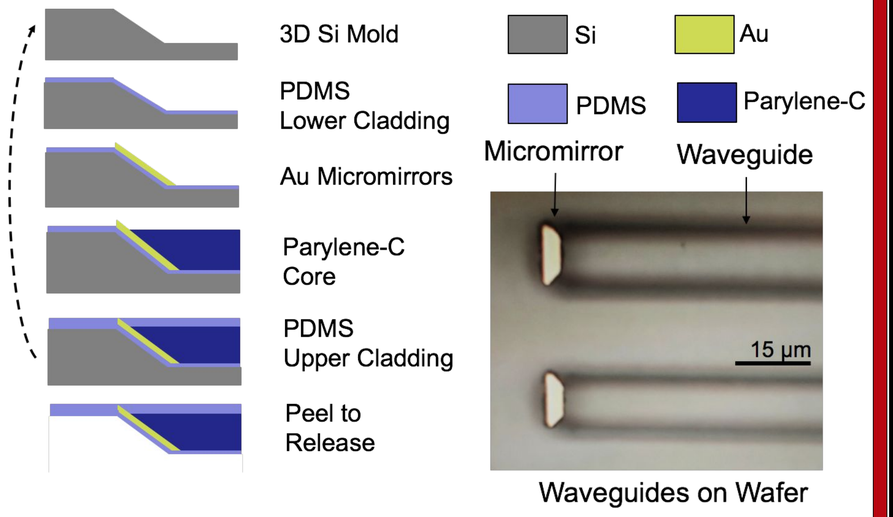
Our Probe Architecture:



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:

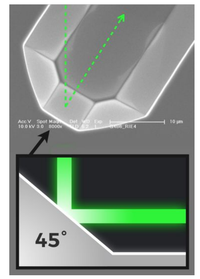


Waveguides on Wafer

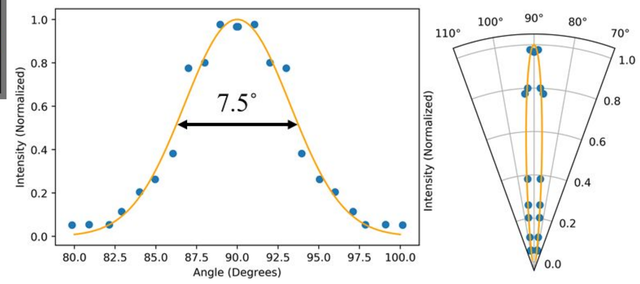
45° micro-mirrors are patterned in Silicon and transferred to conformally deposited polymer layers to maintain shape using the principles of nanoimprint lithography.

Micro-Mirrors:

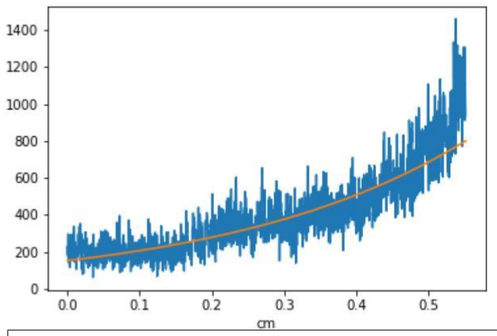
Si Mirror Mold



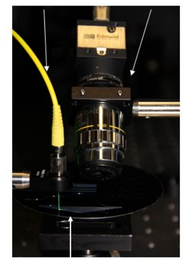
Light incident on the mirror will be redirected out-of-plane.
Our output beam has a divergence angle of 7.5°, allowing highly localized illumination.



Characterization and Loss Optimization:



Input Fiber | Output CCD



Sample Wafer

We estimated propagation loss from the light intensity profile.

Depositing a thin (300 nm) layer of Parylene-C smoothed sidewall roughness and reduced propagation loss of the waveguides by more than 3 fold.