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# Integrated Optical & Electrical Neurophysiology Probes

## Application

- Driver: Sensing and controlling activity of neurons in awake freely moving research mice.
- Selective control of neuron activation has only recently been achieved, using light to trigger transformed neurons
- Market Size: 250-500 research groups world wide, ~$50-150K per group per year annual spending in the area. Some long term overlap with human clinical brain implants.
- Need: Controlling and monitoring activity of individual neurons in genetically modified mice. Selected neurons are made optically sensitive so that neuron firing can be induced with light.

## Research Needs

**Scientific/technological problems and barriers:**

- 5-10 mm long low loss (0.5 dB) multimode optical waveguides integrated onto ~20 um thick, 60 um wide probes, to be inserted into the brain of mice
- Waveguide coupled emitters mounted just above the animal scull, 470 and 570 nm sources, selectable, 10 mW (CW or pseudo CW) coupled power
- 32-64 5-10 um diameter metal sites integrated into this same device, with conductors into the head mounted amplifiers

## Advantages

- Current fiber coupled devices cause considerable animal perturbation. Wireless (battery powered) or thin flexible powered devices would be much preferred.
- Flexibly programmed optical excitation and electrical detection with minimal perturbation of animal behavior.
- Flexible modular design and fabrication platform

## Metric(s) of Progress

Year 1
Low loss polymer planar waveguide fabrication
Low loss coupling of an integrated emitter

Year 2
Switchable emitter color at coupling
Switchable emission site on probe

Year 3 project completion
Integration of multicolor sources with electrical probe
Multi-shank versions fabricated

**Resource requirements:~$0.5-1/yr, 2 FTE plus MEMS fabrication cost through several cycles of design and test]**