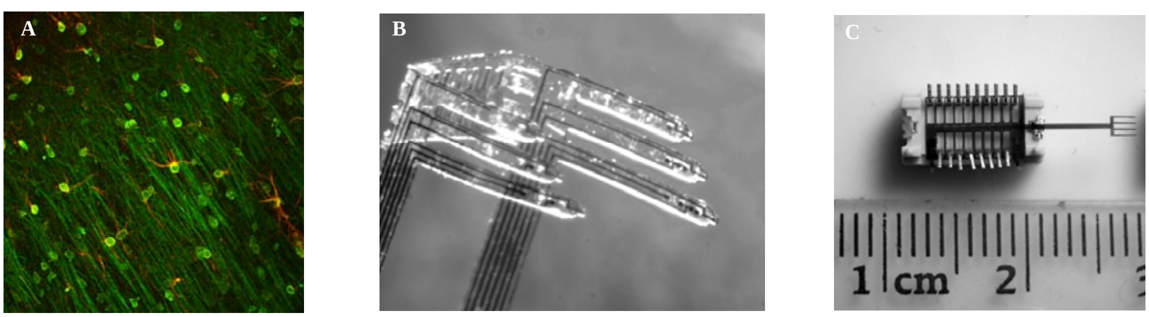
Neural Interface Engineering and Analysis

Neural interfaces provide a means by which information from the outside world can be directly transmitted to appropriate regions of the nervous system (or vice versa). Electrical or chemical microdevices implanted into the brain may one day prove effective as a clinical treatment for certain types of blindness, deafness or paralysis. To create effective, long-lasting and biocompatible implant systems is a tremendous engineering challenge. The overall strategy is to incorporate mechanically flexible materials and enhance the neuron/device interface using biological surface coatings while simultaneously suppressing the body's natural inclination towards rejection of implanted systems. In this project, both *in vivo* and *in vitro* approaches will be used in the continuing development and analysis of effective neural interfaces within the Neural Engineering Laboratory at UIC [6-8].

Students will be involved in one of several aspects of neural interface engineering including development and testing both in vivo and in vitro. Development activities will include applying biological surface coatings to synthetic materials, and evaluating surfaces using a variety of techniques. For in vitro experiments, students will learn surgical techniques to create an effective testbed for the performance evaluation of a variety of candidate biological coatings on implanted devices. Assessment of coating efficiency will be made using advanced microscopy techniques, including fluoresence microscopy, electron microscopy and 3-D confocal microscopy (e.g., see figure below). Students will be responsible for surgical implant, sample preparation and final image processing and development. In addition, students will use the implanted structures to better understand neural processing during brain diseases such as stroke.



A) A MAP-2/DAPI/GFAP immuno-stained fluorescent confocal image from unimplanted rat brain tissue (neurons and nuclei green, astrocytes red) B) a 10 channel, multi-shaft neural interface made with polymide C) A 4-shaft interface ready for implant.

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6. PJ. Rousche, RS Clement, C Visser, JM Cruz and J Si, "Neurabotics: Advanced Studies in Brain-Computer-Interface systems". 1st Annual IEEE conference on Neural Engineering, Capri, Italy, 2003

7. Williams JC, Holecko MM 2nd, Massia SP, Rousche P, Kipke DR. Multi-site incorporation of bioactive matrices into MEMS-based neural probes. J. Neural Eng. Dec;2(4), 2005

8. Das R, Gandhi D, Krishnan S, Saggere L, Rousche PJ., "A benchtop system to assess cortical neural interface micromechanics." IEEE Trans Biomed Eng. Jun;54(6 Pt 1):1089-96. 2007