

Microelectrodes for Electrocorticography – design, fabrication and testing

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Background

- Brain stimulation has been seen as a promising therapy for treating neurodegenerative diseases.
- Neurodegenerative diseases can affect the metabolic state of neurons, so there is a need to simultaneously monitor the activity and metabolic demand of neurons.
- Electrocorticography (ECoG) can be used to monitor neuronal function in cortical layers.

Research Objective and Methods

- The aim of this research is to design, develop, and test MR compatible electrodes that simultaneously measure the partial pressure of oxygen (pO_2) and local field potentials (LFP) from cortical brain structures in rodents.
- Two approaches were attempted – 1. Carbon Nanotube Films (CNT) were laser cut to form electrodes. 2. Poly(methyl methacrylate) (PMMA) was laser cut to serve as a mold for poly-dimethyl siloxane (PDMS) to be cast onto. Carbon paste was dispensed into the PDMS wells.

Results

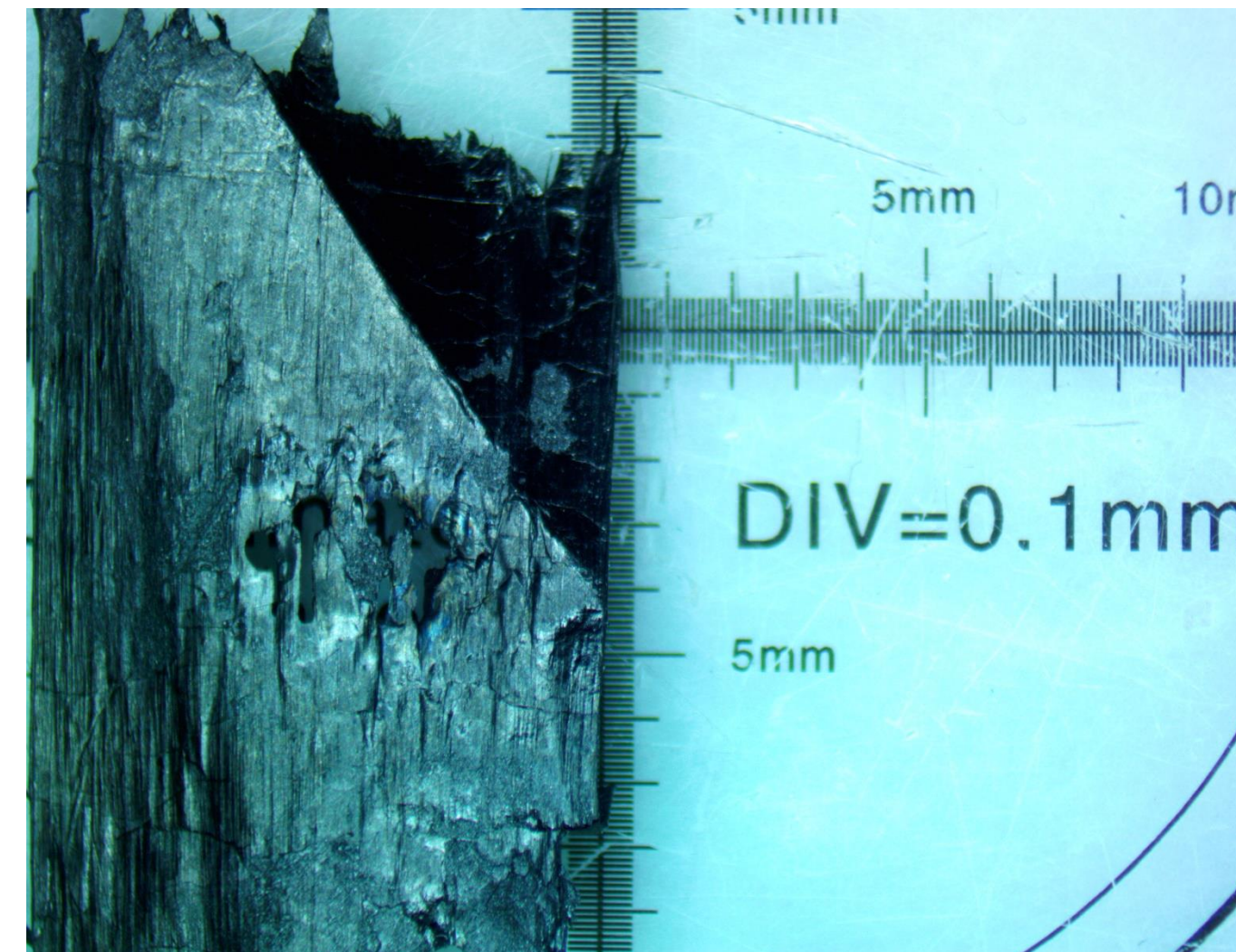


Fig 1. CNT Film laser cut with electrode pattern

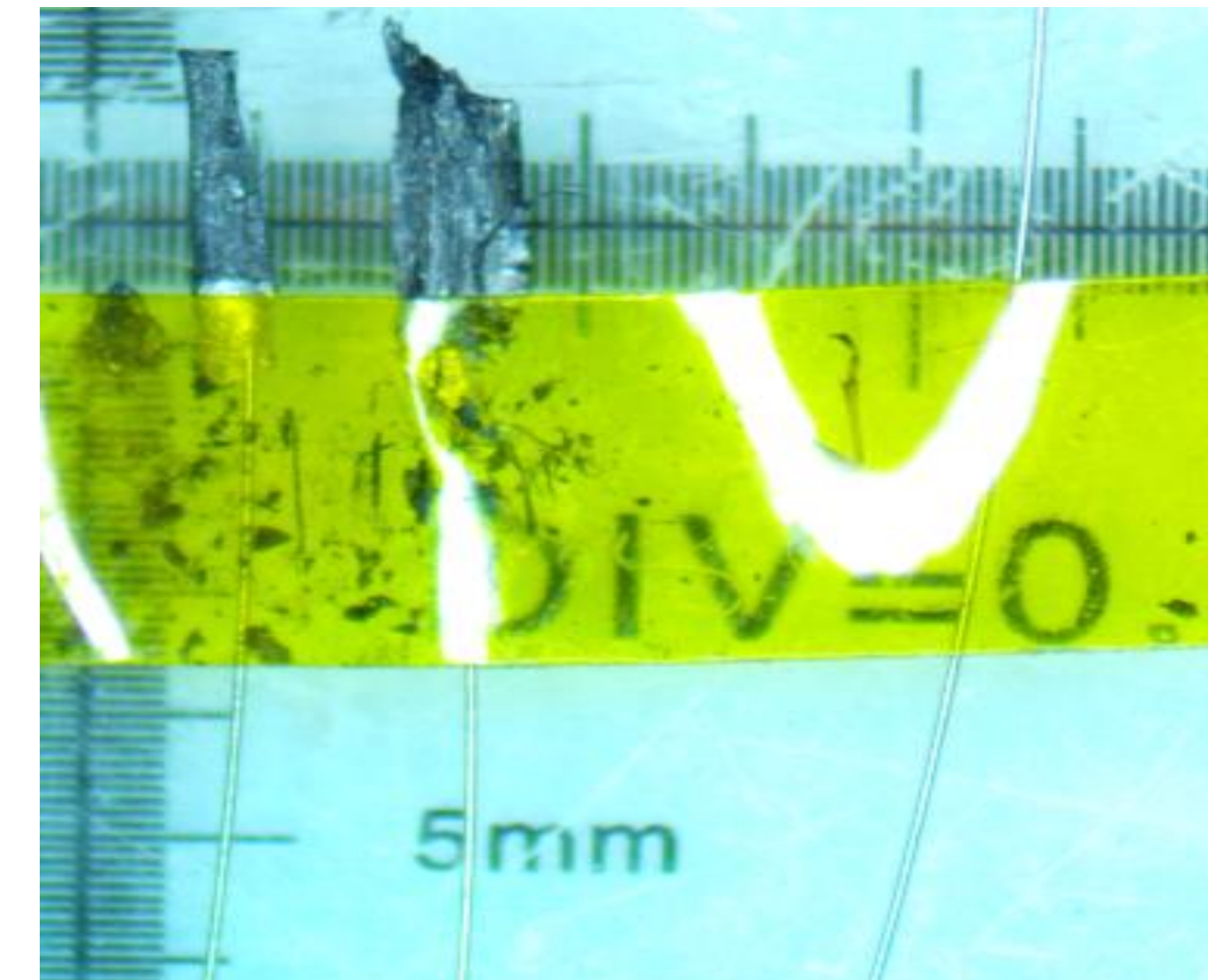


Fig 2. CNT Film electrodes

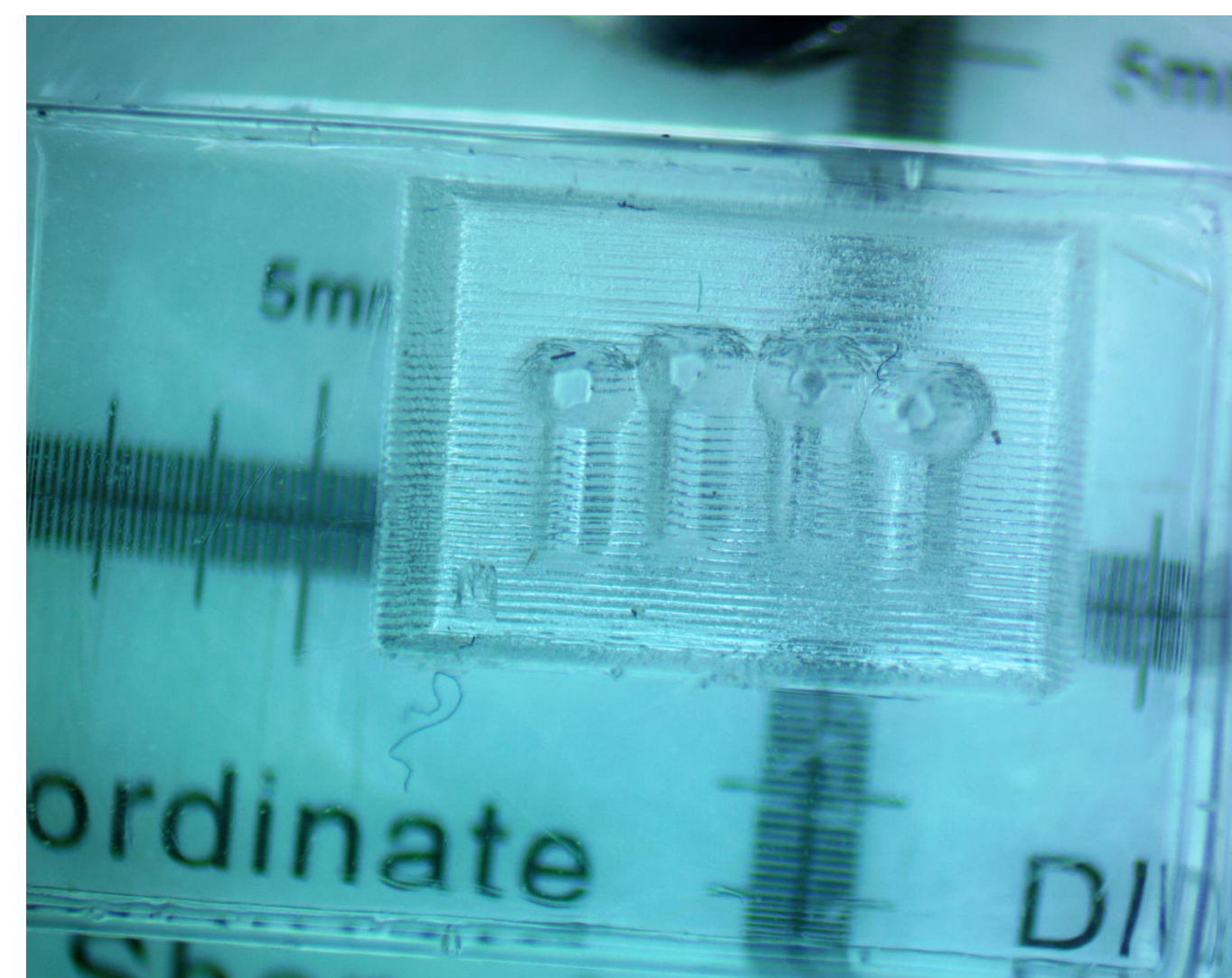


Fig 3. Laser cut PMMA mold for PDMS

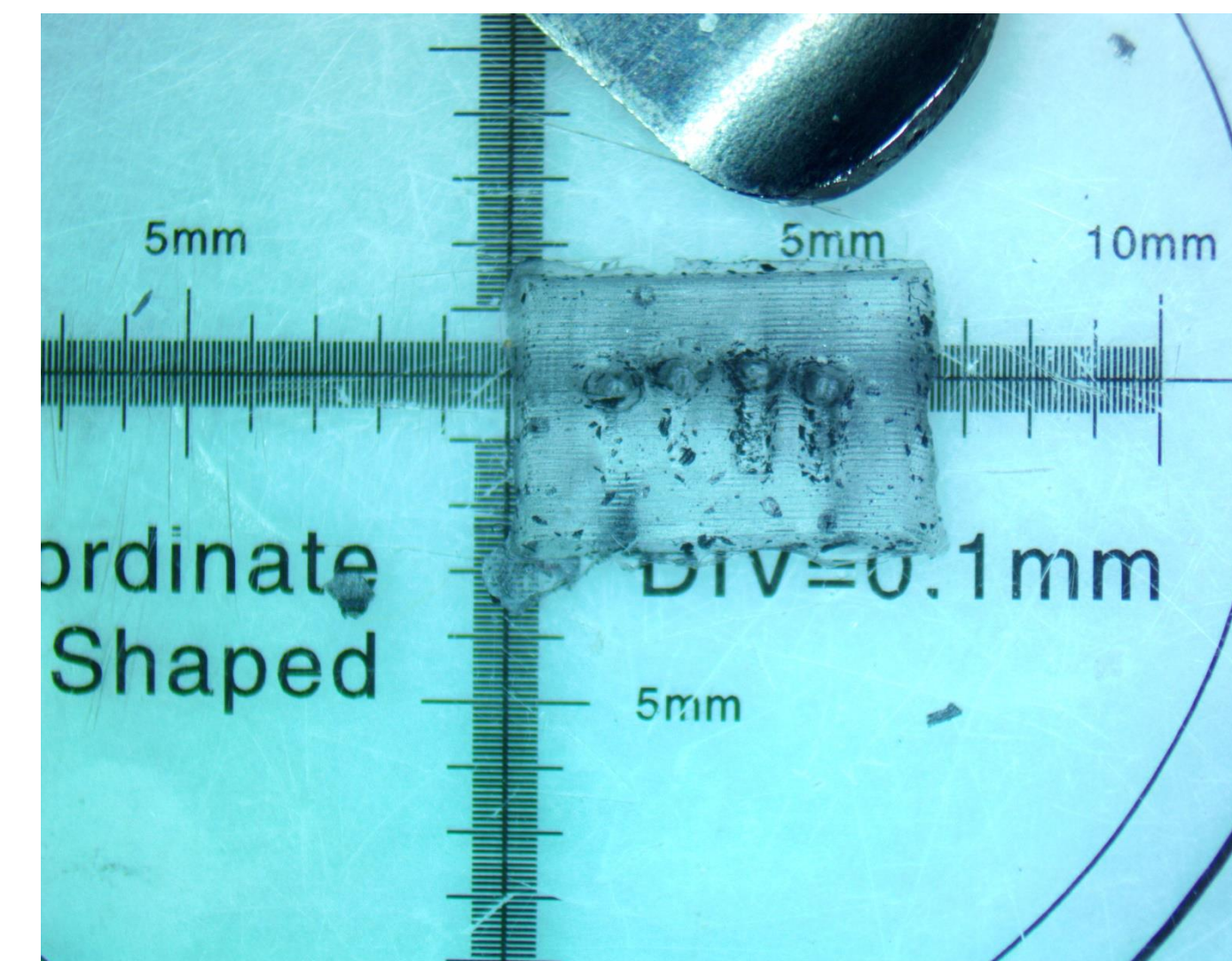


Fig 4. PDMS mold for carbon paste electrodes

Discussion

- Laser cutting can be used to fabricate microelectrodes for measuring neuronal activity in rodents
- Laser cutting burns through CNT film
- PDMS can be cast onto an acrylic master mold to form an electrode pattern
- Electrical shorts form between electrode sites when they are filled with carbon paste

Conclusion and Future Work

- Laser cut microelectrodes can be used to study neuronal activity
- Optimization of carbon paste dispensing and laser cutting parameters
- Incorporate contrast agent capable of sensing pO_2 around microelectrodes using magnetic resonance imaging (MRI).