(Poster only)
Topic Area – Materials and Devices

Fabrication of a Parylene-based Microforce Sensor Array for an Epiretinal Prosthesis

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The aim of this work is to quantify the mechanically-induced impairment of electrical function of neurons in order to improve the efficacy of implantable neural prosthetics. We present a microfabricated array of force sensors integrated on a Parylene support substrate intended to mimic the mechanics of a Parylene-based epiretinal microelectrode array. We present the fabrication and testing of the array and its application to the measurement of implant tacking force and interfacial pressures

Each sensor in the array consists of a Parylene-based liquid-filled biomimetic structure. Due to aqueous ocular environment and fact that soft tissues and cells are predominantly composed of water, a biomimetic approach was selected. This provides a superior mechanical match to the soft retinal tissue when compared to traditional pressure and force sensing technologies, such as silicon-based transducers. Each biomimetic sensor in the array can transduce force over a ~300μm^2 area. The array contains 16 individual sensors providing a 4×4 pixelated image of the force distribution over a 2mm^2 area. Each sensor operates on the principle of liquid impedance-based transduction. A deformable, liquid-filled chamber bounded by a thin (<4μm) membrane makes contact with the tissue and the resulting deflections of this membrane produce a corresponding change in the measured impedance of the liquid. The array represents an instrumented "micro-bubble wrap" surface where each liquid filled bubble is an individual sensor.

Fabrication of the array consists of depositing Parylene C on a soda lime substrate followed by a lift-off process to lithographically pattern the wiring and electrodes for each device. This is followed by patterning of a sacrificial photoresist structure for the inlet channels to the microchamber structure. The sacrificial photoresist is coated in Parylene and vias are opened via etching in oxygen plasma (100 W, 100mT). A second sacrificial photoresist layer is patterned forming each chamber structure (300μm diameter, 10-20 μm height). A final Parylene deposition step forms the final structure. Removal of the sacrificial photoresist and filling of the devices is accomplished through sequential soaking in acetone, isopropyl alcohol and deionized (DI) water.

Preliminary characterization and testing of the sensors demonstrates the ability to measure forces up to 2000 μN, corresponding to a maximum pressure of 4.1psi. Recent studies indicate that this is well within the range of pressure exerted on the retina by the implant. These sensor array presented here will provide the first quantitative data of interfacial forces between the implant and the retina through accurate representation of a Parylene-based epiretinal prosthesis.

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