ENGINEERING THE ELECTRODE-TISSUE INTERFACE WITH ELECTROCONDUCTIVE HYDROGELS

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The long term biocompatibility and electrical performance of implantable biosensors for physiological status monitoring and electrodes for deep brain stimulation are of paramount importance in trauma care and as neuronal prostheses, respectively. We have developed approaches to the design of these tissue-to-electrode interfaces based on the use of *biomimetic* electroconductive hydrogel *co-networks*. Hydrogels are rendered electroconductive through the formation of *electrically conductive* polymer or single walled carbon nano tube networks within cross-linked, highly hydrophilic polymer networks. Our approach to biocompatibility employs *biomimicry* - the creation of *biocompatible* interfaces that emulate the chemistry and topography of the extracellular matrix or of cells of the tissue bed within which the indwelling device must reside. Current biointerfaces were formed from tetraethyleneglycol diacrylate (TEGDA) crosslinked hydroxyethylmethacrylate (HEMA) and incorporated polypyrrole (PPy) to provide interference screening [1, 2] of endogenous interferents, while polyethylene glycol methacyrlate (PEGMA; 0.3 – 0.5 mol%) and 2-methacryloyloxyethyl phosphorylcholine (MPC; 5 – 10 mol%) were introduced to provide *in vivo* biocompatibility [3]. Similar formulations containing 95% purified SWNT were prepared by ultrasonication. Biointerfaces demonstrate very low impedance, high human muscle fibroblast cell viability (> 80%) and low proliferation (< 40%), strongly suggesting a lack of significant cytotoxicity. Deposition of these electroconductive hydrogel *co-networks* onto microdisc electrode arrays [4] resulted in enhanced sensitivity and dynamic range for the detection of electroactive species [5]. Bioactive electroconductive hydrogel co-networks were made responsive to glucose and lactate by the inclusion of glucose oxidase and lactate oxidase-linked CNTs that were covalently tethered to the microdisc electrode surface via alkane thiol chemistries.

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