Electrically Conducting Polymer-Based Biomaterials for Neural Tissue Engineering

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Electroconducting polymers, especially polypyrrole (PPy), have attracted much attention for use in numerous biomedical applications for local delivery of electrical stimuli to target tissues. For nerve tissue scaffolds, three-dimensional nanofibrous meshes were fabricated by depositing nano-thick PPy onto electrospun PLGA nanofibers for electrical stimulation of neuronal cells through conducting nanofibers. Furthermore, neurotrophic activity has been incorporated into conducting nanofibers by chemical conjugation of nerve growth factor. As another work, biocompatibility of neural prosthetic probes was improved by passivating electrodes with pyrrole-conjugated hyaluronic acid (HA) derivatives. Electrochemical polymerization of pyrrole-HA onto electrodes resulted in the minimal adhesion and migration of reactive astrocytes on the HA-coated electrodes at least 3 months. Implantation of HA-coated probes into rat cortices for three weeks revealed attenuated reactive astrocyte responses from the modified electrodes. The ultimate progression of these studies will facilitate the use of electrically conducting materials as bio-interfaces.