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Flexible electronics: Toward growth factors delivery and electrical stimulation of cells for treatment of neurodegenerative disorder

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Aberrant neuronal growth underlies the prefrontal cortical (PFC) pathology of many neurodegenerative disorders. Current treatments are inadequate and commonly cause severe side effects. Importantly, conventional pharmacotherapy strategies have limited efficacy in treating PFC dis-regulation in neurodegenerative disorders. Electrical stimulation is a modern treatment method which can include electroconvulsive therapy, Deep-Brain Stimulation (DBS) and epidural stimulation, etc. Previous studied showed that the application of electrical stimulations promotes neuritis outgrowth resulted to inter neuronal networking. Wide range of metallic microelectrodes composed of gold, steel, platinum etc. have been previously utilized to perform electrical stimulation however, rigidity, incompatible mechanical properties, high initial impedance and low charge-transfer capacity limit their application. Graphene and its derivatives are an exciting class of materials, which are utilized in microelectrodes due to having excellent mechanical stability, electrical conductivity, biocompatibility, flexibility and ability to fabricate and scale up. This work develops three-dimensional (3D) flexible electrode composed of 3D printed Reduced Liquid Crystalline Graphene Oxide (rLCGO) on a polyurethane (PU) substrate. The flexible conducting electrode is used as Host Template for Human Neural Stem Cells (hNSCs) development during proliferation and differentiation. The application of electrical stimulation on hNSC using graphene/PU electrodes revealed promising results to improve neurites guidance through 3D printed lines and enhanced cell-cell communication and networking.

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