Abstract Submission Form: TERMIS EU 2019, 27th to 31st of May 2019, Rhodes, Greece

Opto-electrical fiber for real-time optical stimulation and electrochemical detection of dopamine exocytosis

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INTRODUCTION: Parkinson's disease (PD) is characterized by the degeneration of dopaminergic neurons in the midbrain resulting in dopamine depletion. Continuous delivery of dopamine has shown to reduce the risks associated with chronic motor complications [1]. Here we describe a leaky opto-electrical carbon fiber as a potential neural implant for continuous supply and real-time modulation of dopamine in striatum using stem cells, optogenetics and electrochemistry.

METHODS:
The polymer buffer layer on a commercial optical fiber was pyrolysed at 900 °C to obtain a carbon layer around the optical fiber. Pyrolysed carbon has proven to be biocompatible and to enhance the differentiation of human neural stem cells (hNSCs) into dopaminergic neurons [2]. The carbon-coated optical fiber was made leaky by using laser micro-ablation. Optogenetically modified hNSCs were cultured and differentiated *in vitro* on the fiber for 11 days (Figure 1a).

RESULTS: Figure 1b shows the initial amperometry results obtained first from potassium-induced depolarization followed by optical stimulation using blue light (460 nm). The peak heights are a direct measure of dopamine exocytosis from the cells. By comparing the current peaks, we see dopamine release from a large number of optogenetically modified dopaminergic neurons in the population. This dopamine can regulate physiological dopamine levels in the brain.

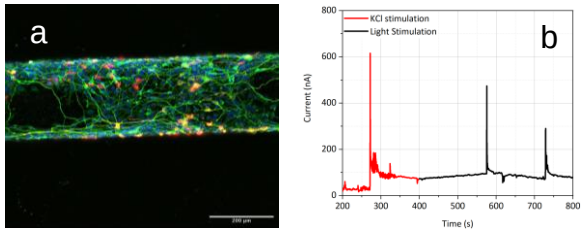

Figure 1: (a) Immunohistochemistry of opto-genetically modified hNSCs cultured on the fiber (Red: Tyrosine hydroxylase, Green: beta-tubulin, Blue: Nuclei). (b) Amperometry results showing chemical followed by optical stimulation.

DISCUSSION & CONCLUSIONS: These initial results provide the first proof of concept for continuous real-time monitoring of dopamine release from stem cells cultured on the opto-electrical carbon fiber and its potential for use as PD therapy.

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[1] J. A. Obeso et al. Eur. J. Neurosci., 6, 889–897 (1994)

[2] L. Amato et al. Adv. Funct. Mater, 24, 7042 (2014)

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