Pyrolytic 3D carbon scaffolds for cell replacement therapy and tissue engineering

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Motivation and field of application
Parkinson’s disease (PD) is the second most common neurodegenerative disease caused by gradual deterioration and finally total death of dopaminergic neurons in Substantia Nigra pars compacta, leading to the depletion of dopamine (DA). Its progress is manifested as impairment of the motor functions. Transplantation of dopaminergic neuronal stem cells (NSCs) (stem cell therapy) has become a new possible long-term treatment. NSCs can integrate into the brain, replenishing the supply of dopamine.

General and principal activities
In a recent study we have shown that an SU-8 derived carbon pillar array remarkably boosted the differentiation of human neuronal stem cells (hNSCs) into dopaminergic neurons (dopamine producing neurons), and that the pillars topography could be used to directly measure and confirm the dopaminergic phenotype of these neurons. This new project involves the exploration of pyrolytic 3D carbon scaffolds of different topography, porosity and conductivity by novel fabrication techniques. 3D carbon microelectrodes will be fabricated and used as both scaffold and sensor simultaneously. The 3D microelectrodes will provide: 1) optimal properties to support cell adhesion, growth and differentiation, 2) electric conductivity to electrochemically monitor in situ and real time cell fate (i.e. dopamine release).

Learning objectives (technical tools and analytical methods, experimental methodologies)
You will gain knowledge in various scientific areas: Electrodes design and fabrication (cleanroom facilities), Micromilling/Laser ablation/3D Printing, Cell culturing, Electrochemical techniques for surface characterization and cell-based assays, Staining and Microscopy, Data analysis, statistics and critical evaluation of the results. Moreover the student will get experience on summarizing and presenting scientific results.

Location where the work will be carried out:
Department of Micro- and Nanotechnology, Technical University of Denmark

Additional information
Maximum number of students: 1

Support for financial aid/scholarship: DTU will not provide any financial support/scholarship.