IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

An *in vitro* investigation of electrospun amyloid scaffolds and their influence on neural stem cell fate.

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Monash University supervisors: Dr David Nisbet, Dr John Forsythe
Monash University contact: Dr David Nisbet, department of Materials Engineering and Division of Biological Engineering, Monash University Victoria 3800, Australia. Ph: +61 3 9905 5345, david.nisbet@eng.monash.edu.au

IITB supervisors: Dr Samir Maji
IITB contact: Dr Samir Maji, samirmaji@iitb.ac.in

Research Academy theme/s

List only the research academy theme/s that is relevant to the project

1. Nanotechnology
2. Biotechnology and stem cell research

The research problem

Disease or injury of the brain can currently not be recovered, which has severe consequences for the patient. This study that aims to restore damaged neural pathways within the brain using novel bio-nanotechnology approaches. Whilst we will specifically target Parkinson's Disease (PD), the work will also have positive implications for many other brain disorders. We propose to achieve this through bioengineering a synthetic, nanostructured scaffold from amyloids that will have a capacity to self-assemble, deliver replacement cells and provide a niche microenvironment for their proliferation and differentiation, whilst also encouraging the re-formation of synapses. We will also attempt to use the scaffold to by-pass many of the inhibitory process that occurs in the adult CNS. No existing scaffold has thus far been able to achieve this. A major part of this proposal is to biofunctionalise the amyloid scaffolds with factors such as semiphorins, cadherins, growth factors and ephrins etc to firstly facilitate attachment and proliferation of cells seeded on the scaffolds in vitro, with the ultimate aim of translating this to *in vivo* applications.

Project aims

1) Engineer nanofibrous scaffolds from amyloids that have the added capacity of self-assembly to instruct stem cell behaviour. This will involve the fabrication of niche cellular microenvironments that encourage stem cell differentiation (towards desired phenotypes), proliferation, migration and process elongation.
2) We will optimise the scaffolds to include incorporate; growth factors support; favourable cellular interactions and mechanical support to direct stem cells fate and process elongation *in vitro*.
3) We will use these scaffolds, during the optimisation process to study neurogenesis, in anticipation of gaining a better understanding and applying this to be able to regenerate neural pathways within the brain.

Expected outcomes

This scaffold is fabricated to control and instruct stem cell behaviour *in vitro*. We will also be able to use this scaffolds as a cell culture tool to study neurogenesis.

Which of the above Theme does this project address?

This project will address 2 of the Theme's. 1) Nanotechnology and 2) Biotechnology and stem cell research.

How will the project address the Goals of the above Themes?

Here we will use bionanotechnological principles to attempt to fabricate smart scaffolds from amyloids that also have the capacity to self-assemble. We will generate scaffolds with nano-archeticture that mimic the morphological features of the natural extra cellular matrix as an attempt to influence and control neural stem cell behaviour (Nanotechnology). We will then culture stem cells on these scaffolds, and continually functionalise and optimise them, with the direct aim of achieving the regeneration of neural pathways within the brain. We will gain insight for this through using these scaffolds to study neurogenesis *in vitro* (biotechnology and stem cells research).