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Engineering patterned human brain cells on silicon chip

Charles P. Unsworth
University of Auckland, New Zealand

The human brain consists of over 100 billion neurons and one order of magnitude more in supportive glia. Thus, large network studies of the brain at the single cell level become difficult due to the entwined growth of neurons and glial cells in the neocortex.

In Neuroengineering, the field of cell patterning promises precise placement of individual cells and their arrangement into organised networks. The majority of studies in cell patterning are limited to small model organisms and rodent studies due to ethics, cost and quick reproduction. However, better models of the pathological human brain, require brain cells derived from human tissue, as their properties provide a better match than those of the commonly used embryonic rat.

One alternative to primary tissue is that of stem cell lines which can provide an accessible way to provide large quantities of well characterised neurons. In particular, the human hNT neuron (derived from the human teratocarcinoma cell line (hNT)) and its supportive cell, the hNT astrocyte, express ubiquitous neuronal/astrocytic markers, are widely available and provide the closest model to healthy, adult, functional, human neural tissue. Furthermore, they raise no ethical concerns as neurons are differentiated from an immortalised cell line rather than embryonic tissue.

In this seminar, I will discuss the protocol we developed to pattern the first human hNT neurons on parylene-C/SiO2 substrates and how, in our more recent work, we have patterned the first hNT astrocyte, on such substrates to single cell resolution.

Biography

Charles Unsworth, Senior Lecturer, obtained his PhD in Physics at the University of St. Andrews, UK in 1997. He is an Ex. Higher Scientific Officer of the Defense Evaluation Research Agency (DERA) Ministry of Defense, UK. He completed a 3 year Postdoctoral Fellow at the University of Edinburgh in Radar Signal Processing and a 2 year Postdoctoral Mobility Fellow at Edinburgh University collaborating with the Royal Hospital of Sick Children, Edinburgh in Biomedical Signal Processing. He runs the 'Advanced Signal & Image Processing Group', at the University of Auckland specialising in Biomedical Signal Processing & Neuroengineering.

c.unsworth@auckland.ac.nz