Project Name:
Stem cell bioengineering: Synthetic programmable niches for the vascular differentiation of human embryonic stem cells

Professor Robert Langer, Chemical Engineering and Biological Engineering, MIT

Project overview:
Despite the significant advances in the differentiation of stem cells into different cell lineages, the number of desired cells is generally low which requires the development of new approaches to solve this issue. This project aims to develop novel micro- and nanotechnologies to control the differentiation of stem cells, in particular human embryonic stem cells, and to understand the effect of synthetic stem cell niches in their differentiation.

Faculty involved: Robert Langer and Lino Ferreira

PhD student involved: Jason Fuller

Deliverables: Intracellular delivery of core-shell fluorescent silica nanoparticles, *ScienceDirect, Biomaterials (29) 1526-1532, 2008, J.E. Fuller, G.T. Zugates, L.Ferreira, H.S. Ow, N.N. Nguyen, U.B. Wiesner, R. Langer*

Results: Highly fluorescent core-shell silica nanoparticles made by the modified Stober process (C dots) are promising as tools for sensing and imaging subcellular agents and structures but will only be useful if they can be easily delivered to the cytoplasm of the subject cells. The results obtained so far show that C dots can be electrostatically coated with cationic polymers, changing their surface charge and enabling them to escape from endosomes and enter the cytoplasm and nucleus. As an example of cellular delivery, we demonstrate that these particles can also be complexed with DNA and mediate and trace DNA delivery and gene expression.

Timeline: At the present, we are developing a new approach to release bioactive molecules within human embryoid bodies.