Cells can be cultured and sorted on specifically patterned surfaces of biomaterials

October 22 2010

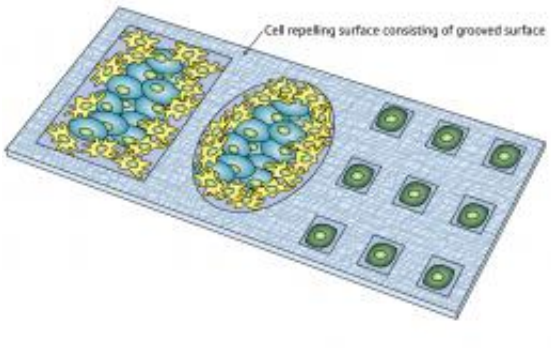

Figure 1: Cells can be corralled on a chip in different ways by etching grooves into its surface. Depending on the area and shape of non-etched areas, cells can be separated and cultured either singly or in clumps of different forms. Credit: 2010 Hiromi Miyoshi

Patterns of grooves etched into the surface of a silicon chip can guide, trap and filter migrating cells, biomaterials scientists from Japan and Korea have discovered. The results open the way to engineering surfaces to study the movement of particular cell types during development and cancer, or to confine cells in tissue culture and protect against interference by cellular invaders. As the technique is biologically non-invasive, it should be ready for use in biomedical applications without years of safety testing.

The research team is led by Taiji Adachi of the RIKEN Innovation Center in Wako and includes colleagues from that institute and Pusan National University in Korea. Using time-lapse photography the researchers observed the behavior of the epidermal cells associated with fish scales known as keratocytes. These cells migrate rapidly and are often used in studies of cell movement.

Hiromi Miyoshi, a researcher of Adachi's team and her colleagues engineered grooves of different dimensions in the silicon dioxide coating of a silicon chip. The grooves were all 20 micrometers deep but of three different widths -- 1.5, 4 and 20 micrometers. Initially, the researchers observed what happened when moving cells encountered a single groove of these dimensions. They then etched a rectangular crisscross pattern of intersecting grooves 1.5 and 4 micrometers wide and the same depth. The widths were carefully selected with respect to the dimensions of the cells. Four micrometers is about the size of the cell nucleus and 20 micrometers the reach of the moving front of the cell, Miyoshi explains.

When the migrating cells encountered a single groove, they responded in one of three different ways. Some simply crossed the groove, some turned back, and some moved into and along the groove since they were constrained by it. As the width of the groove decreased, the proportion of cells turning back increased to the point where, at 1.5 micrometers, there were no cells crossing and more than 90% turned back.

The intersecting grooves four micrometers wide tended to slow movement of the cells considerably, and in some cases stop or trap the cells. As it is known from previous work that different cell types respond differently to the topography of the surface over which they travel, the researchers suggest that different etched patterns could be used to filter or exclude individual cell types.

“We are now planning a more detailed study of cell migration in a three-

dimensional environment," says Miyoshi.

More information: Miyoshi, H., et al. Control of highly migratory cells by microstructured surface based on transient change in cell behavior. Biomaterials 31, 8539–8545 (2010).

Provided by RIKEN