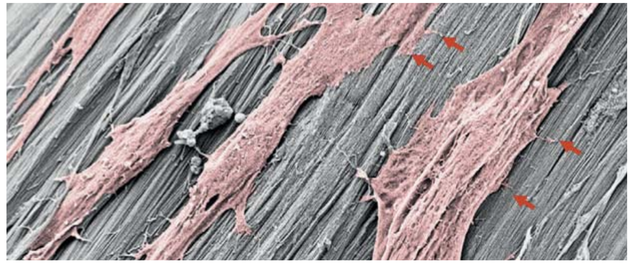
THE GRAND CELL TRACKING EXPERIMENT

CENTRE FOR BIOSYSTEMS, NEUROSCIENCE AND NANOTECHNOLOGY • COLLEGE OF SCIENCE AND ENGINEERING • CITY UNIVERSITY OF HONG KONG

Possibly the biggest experiment ever done in Hong Kong!

THE SCIENCE



What have we discovered?

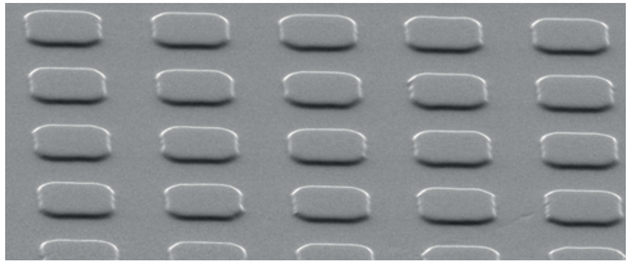
You may not know that most cells in your body, not just cells in blood but also those in your tissues, are in constant motion. Each cell can sense its immediate environment, and use the molecular motors inside to drive its movement in response. Sometimes, cells just “dance” around; in other cases, such as during regeneration and embryonic development, cells migrate from one place to another.

When cells are placed on a plastic surface, they also move around. Although the physical environment of a plastic dish is very different from that inside the human body, the cells respond to it in the same way as in the body and use the same molecular motors to move.

Human cervical cancer cells on a plastic surface

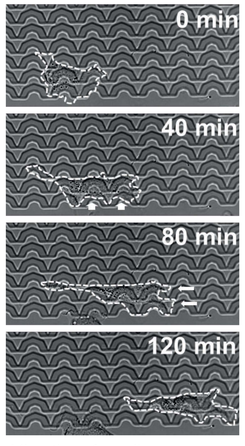
We have discovered that by creating microscopic patterns on the plastic surface, we can “guide” cells into migrating in a predictable direction and speed. Those patterns are very small, even smaller than a human cell, and will induce localized changes in the cell, causing it to change shapes continuously. In doing so, the cell will migrate on the patterned surface in a “programmed” way. We are collecting more data on these behaviours.

THE QUESTION



Why we need your help?

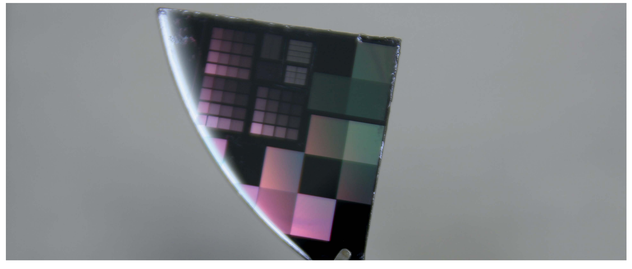
In many ways, cells behave more like human beings than machines. Although we can estimate the general trend of a population, we cannot accurately predict the behaviour of each individual. Therefore, to understand how a patterned surface influences cell migration, we need to track the movement of individual cells within a large group. Only through the analysis of individual cells, the general migration behaviour will emerge.



Migration of a cell on a patterned surface (dotted lines indicate the outline of the cell).

We want you to track the cells for us. It is easy. You will see a time-lapse movie that shows the migration of cells over 19 hours. Choose a cell, and use the cursor to register its location in the first frame of the movie. Then, go to the next frame, register the new position of this cell. Repeat until you have mapped the location of this cell in all the time frame. That’s it! It will take you less than 2 minutes.

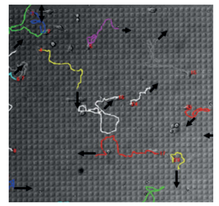
THE DATA



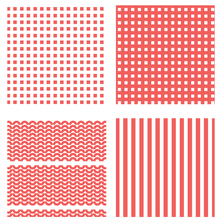
How will your data contribute to science?

Our question: do different types of cancer cells respond to our patterned surface in the same way?

Cancer cells spread from one part of the body to another. Understanding how cancer cells migrate, how they respond to their external environment, and what control the directions and speed of their migration is an essential weapon against them.



Trajectories of cells on a patterned surface



Patterns used in this experiment

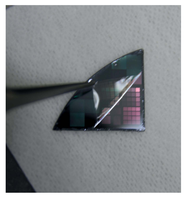
The coordinates of the cell you have entered for us will allow us to record the trajectory of this cell, and calculate its speed and direction moment by moment. These data will help us understand the general behaviour of cells on these patterned surfaces.

Our hope is to use this knowledge to develop apparatuses that allow us to understand how cancer cells move, and devices to control migration of cancer cells.

THE EXPERIMENT

How did we make the time-lapse movies?

The patterned surfaces were made by photolithography, originally developed for making computer microchips. The patterns were first designed on a computer. UV light was then used to transfer the pattern from a photomask to a light-sensitive chemical "photoresist” on a substrate. After a process called etching, a mold was created. Plastic was then casted onto the mold to replicate the pattern. Finally, the patterned substrates were bombarded with oxygen in a process called “plasma treatment”, in order to make the plastic surface suitable for cell growth.



Cancer cells were maintained in a specialised incubator. One day before imaging, they were seeded on the patterned surfaces. The cells will adhere and spread on the surface. Then they were put on a Confocal Laser Scanning Microscope, which automatically took one image of the cells every 10 minutes. The microscope stage is maintained at 37°C, the temperature for the growth of mammalian cells.