Optical Robots

In a few years researchers might use microscopic knives to make ultra precise cuts in a cellular membrane without damaging the interior of the cell.

It's a team of Danish researchers that are working on the development of these unique microscopic instruments at Risø National Laboratory. The new technology will make it possible to work with cells in new ways or to construct new materials put together micro-brick by micro-brick.

American scientists are on the verge of using the new micro-tools in connection with a major cancer research project.

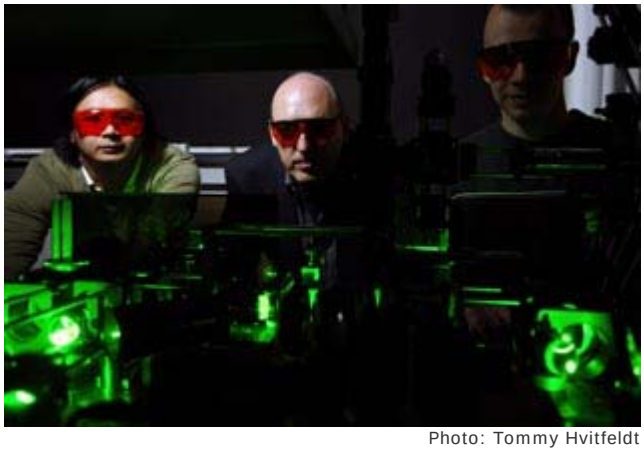

Photo: Tommy Hvitfeldt

The experimental setup at Risø

3D drag-and-drop laser manipulation

The technique is known as 'three-dimensional real-time optical micro-manipulation'. It works by splitting a laser beam into multiple smaller beams.

Light is a form of energy, so each beam is capable of acting with a force on its surroundings. In other words, the beam can be used to push or pull, drag or drop. These properties of the light beams are useful for a variety of purposes.

When you have the ability to coordinate multiple beams to push, drag or pull in different directions, then you can use them to punch holes, to fixate or move objects, and to set micro-vessels in motion.

A plurality of optical hands

The Danish Research Professor, Dr.Techn. Jesper Glückstad, is the head of the research team at Risø that is working to create the new tools, and he is very enthusiastic about the future.

- The possibilities are virtually limitless, partly because we can combine our patented new tools with the well known 'vision

EXTERNAL LINKS

Programmable Phase Optics, Risø National Laboratory

technology' that is already being used in, for example, computer science.

- In a sense what we have done is to create a plurality of optical hands capable of moving objects around in parallel while you are looking at it, even though what you are doing is taking place at the microscopic level, Glückstad explains

- This will provide scientists working in many different disciplines, for example, micro-biology, cancer research, nanotechnology and materials science with a new set of tools that are vastly different from what was available to them before, Glückstad continues.

Laser-driven Micro-bots

The new instruments can also be used to develop specialised optical robots. This type of robot will be capable of executing multiple tasks simultaneously, whereas previously these tasks had to be performed sequentially one at a time.

A clear advantage is that you can get things done faster this way. And, in certain situations time will be of the essence, for example, if you are working in a material as it is hardening, it might be crucial that you can complete multiple tasks simultaneously before the material becomes difficult or impossible to work in.

Another advantage is that it will become possible to let the robots work, for example, to 'fix' the cells in a tissue sample at night while the scientist is at home asleep.

Focus on the instrument platform

The many possible applications make it difficult to pick out a particular area to focus on. Instead Jesper Glückstad has chosen to concentrate on the development of a universal instrument platform or 'tool box'.

'At the moment we are working with the laser beam instruments at a stationary experimental setup at Risø. Our ambition is to develop a setup that is more easily transportable. Ideally we would like to travel with our 'tool box' so we can export and introduce the new technology to research facilities and laboratories all over the world. We hope to be ready with a moveable platform that can be used in many different research contexts within the next couple of years,' Glückstad explains.