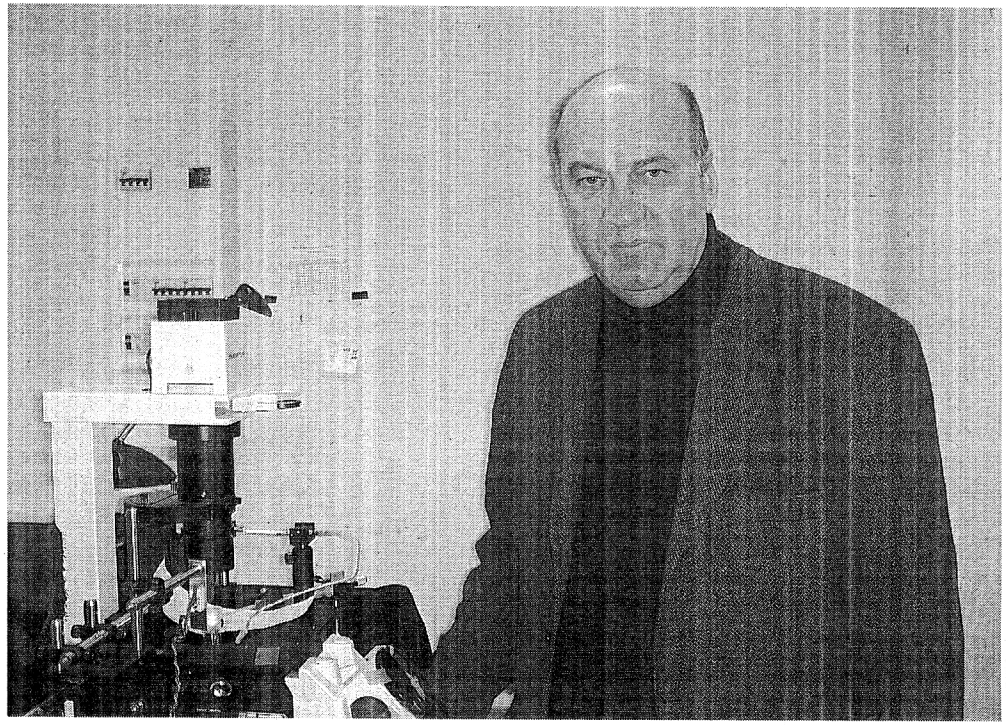
SCIENCE & TECHNOLOGY

Shedding light on biological cells

ICREA researcher Dmitri Petrov uses a non-invasive technique to obtain cell information

GEMMA BERNIELL

Biological cells are a complex mixture of a large number of biomolecules such as proteins, nucleic acids and lipids, enclosed in a cellular membrane. The identification of the biomolecules present in living cells, is crucial for the understanding of various cellular processes. The main biochemical methods used to monitor living cells are often time-consuming, laborious, and require living cells to be immobilised, either physically or chemically, which can change the cells chemical micro-environment.



Dmitri Petrov is a researcher at the Catalan scientific institute ICREA, here in his lab / BIRGITTE LAUSTEN

"A Raman image of a cell is like a fingerprint of the cell's molecular content," says Petrov

The combined use of Raman Spectroscopy and Optical Tweezers, gives rise to a non-invasive technique known as Raman Tweezers, which provides information on biochemical reactions taking place inside single living cells across time, without the need for cell immobilisation. Dmitri Petrov is an ICREA researcher currently employing Raman Tweezers for the biochemical analysis of single living cells.

Optical Tweezers use light to manipulate small objects. Light not only produces energy, but also mechanical pressure. The mechanical pressure from a laser beam that is focused on a spot of a specimen by a high-quality microscope objective is able to trap and hold small particles in what is known as an optical trap. Petrov describes this concept using the example of a comet. "Imagine a comet rotating around the sun," he says, "the comet's tail will never be facing the sun, it will always be on the outside, pushed away by the radiation (mechanical) pressure of the sun. In the lab, we use a focused laser beam as if it were the sun, and direct its pressure to push small particles towards a focal point."

When the optical method is combined with Raman, the following occurs. Light hits a molecule, it is elastically scattered. Most of this light is scattered at the same frequency (energy) as the incident light, except for a small fraction of light that is scattered at lower frequencies due to energies of molecular vibrations. The process leading to this inelastic scattering of light is referred to as the Raman effect. Raman Spectroscopy analyses the optical spectrum of the scattered light, from which information about species structures and molecular conformations within the cell can be obtained. "A Raman image of a cell is like a fingerprint of the cell's molecular content," says Petrov.

Dr Petrov's voyage to cell research

BIOGRAPHY

- Dmitri Petrov grew up in Russia at a time when science was one of the state priorities.
- He decided to study Physics and Mathematics at Irkutsk University.
- He then obtained a PhD on diffraction of light on surface acoustic waves at the Institute of Semiconductor Physics, also in Russia.
- Petrov left for Brazil where he spent several years in university teaching.
- He then came to Catalonia to work at the Institut de Ciències Fotòniques de Barcelona, which he says has been one of the most successful parts of his career.

HIS PROJECT

Raman Tweezers can be used to obtain information on what makes living cells move the way they do. Petrov works with a team made up of one post-doctoral student and three PhD students. Their work is highly inter-disciplinary, resulting in close collaborations with researchers from many fields and centres.