

CellSurgeon

Rowiak Nanodissection System



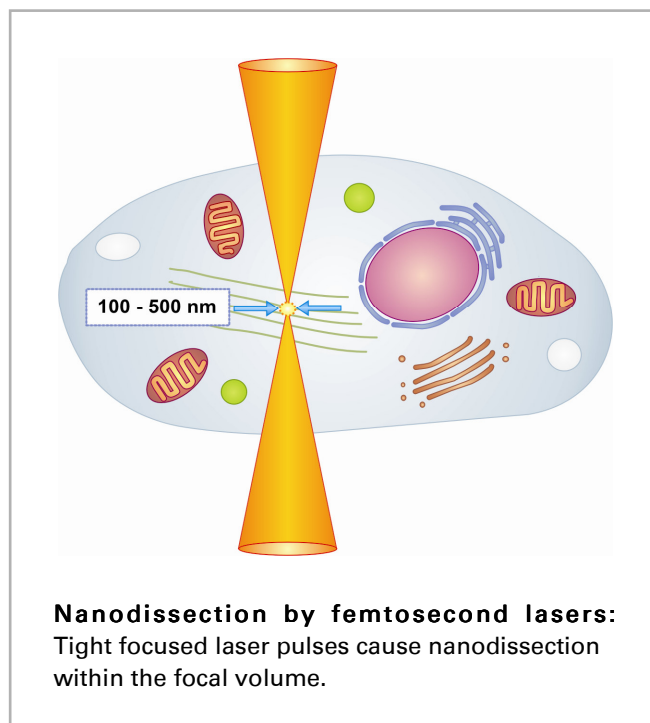
CellSurgeon - Laser Nanodissection

The CellSurgeon is a laser based nanodissection system, designed for gentle and contact-free manipulation of cells and subcellular structures. It can be used to change cell dynamics, to deactivate cell organelles or to influence cellular processes, such as metabolism and apoptosis. Nanodissection with ultra short laser pulses opens new horizons for scientists, who are primarily interested in investigation of cells and cellular processes.

A major advantage of the CellSurgeon is its adaptability to different microscopes and imaging procedures. Thus providing high flexibility, since the device can be used in combination with already existing equipment.

Femtosecond laser technology

Main component of the CellSurgeon is a NIR femtosecond laser. Depending on the configuration the repetition rate varies between some kHz and 90 MHz. Nanodissection with ultra short pulses is based on plasma mediated ablation, induced by high laser intensities



confined to a minimal volume. This is realised by tight focussing the laser radiation. Intensities of some TW/cm^2 can be reached inside the laser focus. These extreme intensities lead to ionisation of the illuminated material by multiphoton absorption and to plasma formation. By explosive expanding, this plasma induces a pressure wave, that finally disrupts the material. With the help of high numerical aperture objectives the lateral extent of the focal volume can be limited to less than one micrometer.

That allows the manipulation of single cell organelles which have a typical size

of some micrometers. Dimensions of manipulation can be influenced by changing either the microscope objective or the laser pulse energy. Under optimised conditions a minimum cutting precision of about 100 nm is possible.

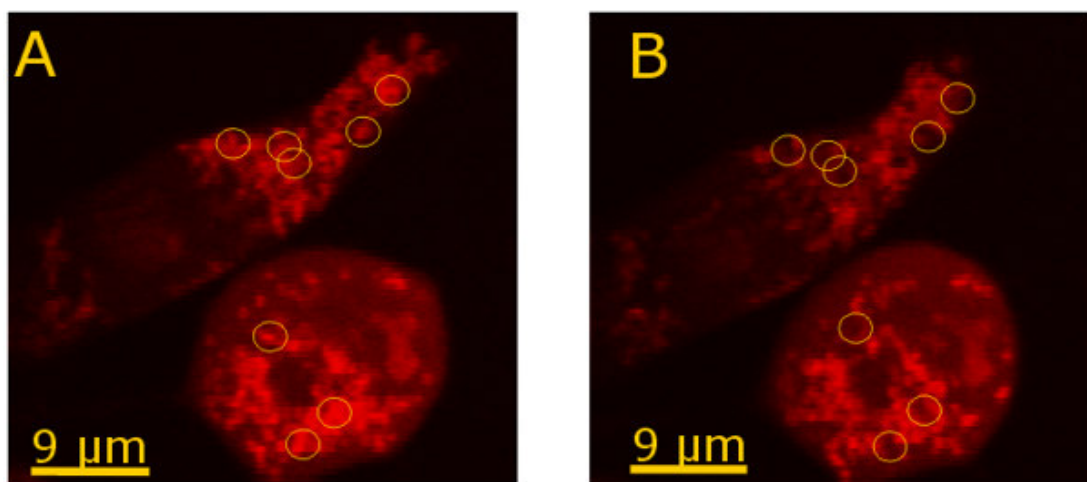
Advantages at a glance

- contact-free nanodissection of cells and cell structures or organelles
- gentle manipulation of living cells, without loss of vitality
- high precision, selectivity and reproducibility
- versatile applications in research and development
- adaptable to different microscopes and imaging procedures
- customised configuration
- intuitive software interface

Gentle manipulation of living cells

Cells, their organelles and structures can be selected with high accuracy. Tightly focused laser pulses and a three-axis piezo stage enable nanometer precision and high reproducibility. The technology allows targeted manipulation of cell parts without damaging others. This considerably improves the success rate of cell manipulation and thus the efficiency of laboratory work.

Because manipulation with femtosecond lasers is based on multiphoton absorption, it is also possible to use this technology for multiphoton microscopy.



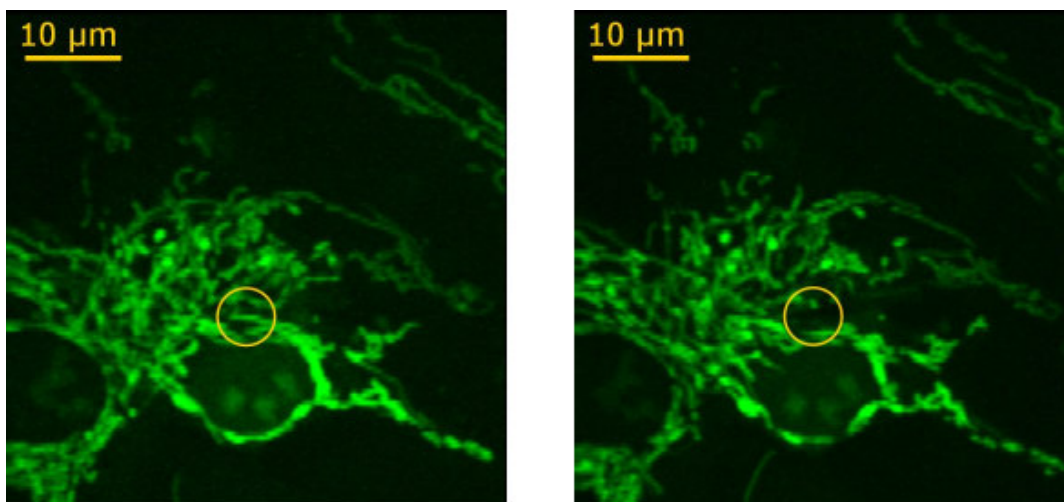
Multiphoton image of two granulosa cells. (A) Cells before manipulation, single mitochondria to be ablated are marked by yellow circles. (B) Cells after manipulation, the ablated mitochondria are missing. (© J. Baumgart, Laser Zentrum Hannover e.V.)

Applications

The CellSurgeon is especially suited for applications in medical and biological research. It can be used to manipulate cells or cell organelles and structures. Depending on pulse energy manipulation levels can vary from stimulation to remodelling or even to a complete deactivation of cell parts. This is especially useful for investigations of cellular processes such as metabolism, apoptosis or cell dynamics. Understanding of cellular and subcellular mechanisms is important for the development of drugs and stem cell or gene-based therapies against diseases such as cancer or Alzheimer's and Parkinson's disease.

Cell transfection is one possible application. By focussing the laser beam for some milliseconds on a cell membrane, transient pores are created and proteins or nucleic acids can enter the cell. Membrane perforation done with a femtosecond laser is a very precise and gentle transfection method that reduces the risk of cell damage to a minimum, as well as improving transfection efficiency. A further potential application is deactivation of specific cell structures, such as mitochondria or microfilaments, in order to understand their role within a cell.

Certainly, there is plenty more to be added to the list of research tasks. The CellSurgeon is a versatile tool, that can help to solve different problems in cell and molecular biology as well as in medicine or pharmacy.



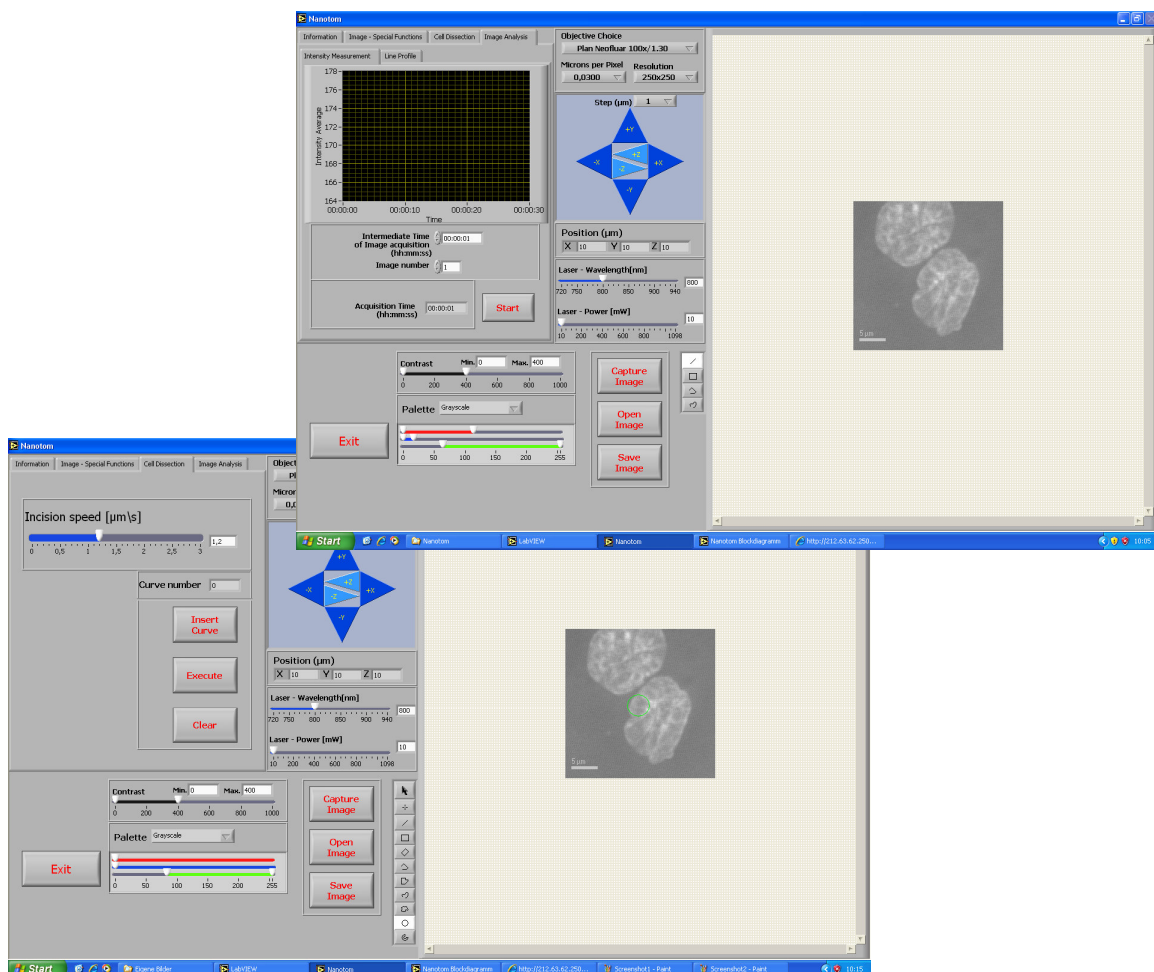
Multiphoton image of endothelia cells. Left: cells before manipulation, single mitochondrion to be ablated is marked by yellow circle; Right: cells after manipulation, the ablated mitochondrion is no more visible. (© J. Baumgart, Laser Zentrum Hannover e.V.)

Software features

The Software with its intuitive user interface makes the CellSurgeon easy to use. A lot of features for analysis, image processing and automated procedures are included.

Software function at a glance:

- versatile nanodissection geometries (single point, line, ROI etc.)
- different scan modi (overview scan, z-Scan)
- intensity measurement
- laser parameter setting
- image processing



Technical data

Femtosecond laser:

- laser system: solid-state, tunable (single-wave on request)
- repetition rate: 80 or 90 MHz
- pulse duration: 140 fs
- wavelength range: NIR (current configuration 720 - 950 nm, others on request)

Three-axis piezo stage:

- resolution piezo: 5 nm
- resolution manual: 50 nm
- travel piezo: 20 μ m
- travel manual: 0.3 mm (fine), 4 mm (coarse)

Rowiak offers customised configurations. Depending on your needs different laser systems, objectives and microscopes are available. Please let us know your requirements!

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