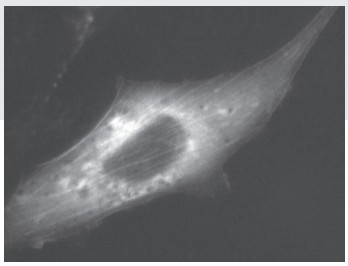
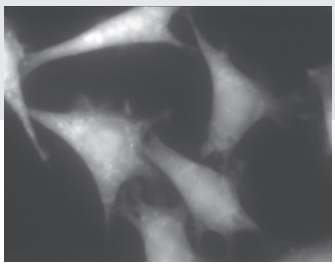
ROWIAK
photons at work

CellSurgeon

Nanopulate the Cell

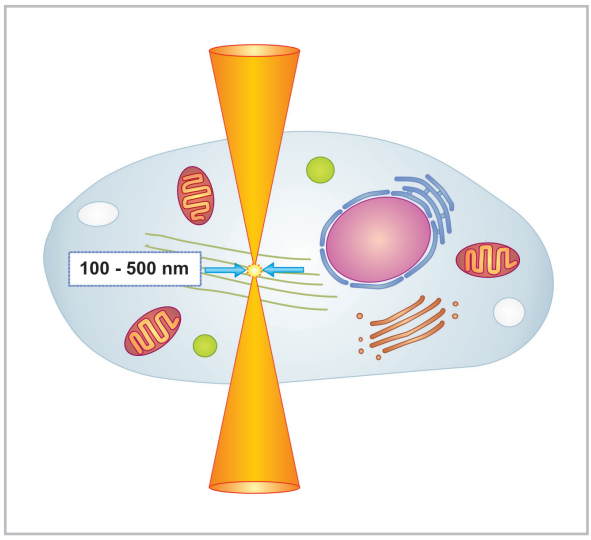
Subcellular Laser Dissection with Nanometer Precision





Laser Nanodissection

Cells, the fundamental units of life, are primary objects of research in biological sciences. Nanosurgery can help to gain a deeper understanding of cellular mechanisms. The Rowiak CellSurgeon is a new laser nanodissection system enabling gentle and contact-free manipulation of living cells or subcellular structures. Applications include, for example, transfection of cells, deactivation of cell organelles or investigation of cell dynamics.



Femtosecond Laser Technology

Main component of the CellSurgeon is a NIR femtosecond laser. The laser beam is coupled into a microscope and tightly focussed by high numerical aperture objectives. Inside the laser focus very high intensities occur, inducing non-linear optical processes and finally leading to ablation.

Gentle manipulation of living cells

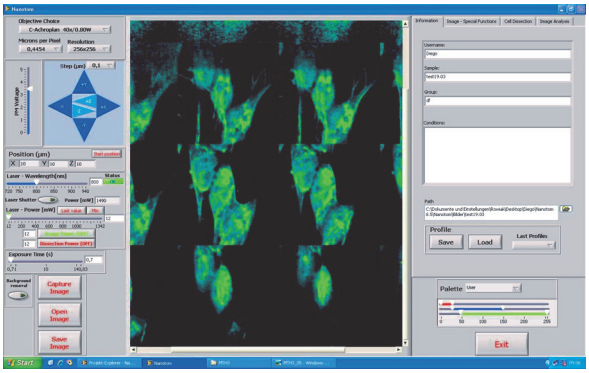
One key advantage of femtosecond lasers is that at a pulse duration in the femtosecond range, only a few nanojoules of energy are necessary for dissection. In contrast, dissection with UV laser systems requires energies that are at least two or three orders of magnitude higher. The low laser energies and the high numerical aperture objectives allow very precise manipulation and dissection on a subcellular level without harming adjacent structures. Depending on the configuration cuts with minimum dimensions of approx. 100 nm are possible. This gentle dissection method reduces the risk of cell death and is therefore especially suited for living cells.

Intuitive software interface

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 functions at a glance

- versatile nanodissection geometries
- different scan modi (overview-, z-scan)
- intensity measurement
- laser parameter setting
- image processing
- three-dimensional ablation

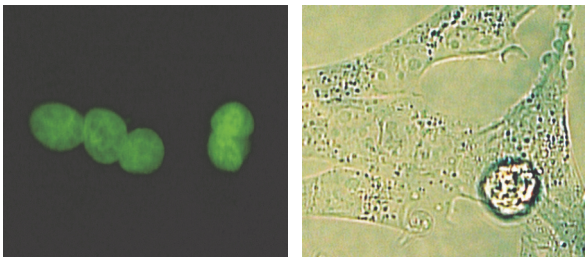


Versatile Applications

The Rowiak CellSurgeon provides a powerful technology platform for precise and gentle nanosurgey in living cells. It is a versatile tool suitable for a wide range of applications in biological, medical and pharmaceutical research. The combination of microscopic imaging techniques with laser nanodissection enables novel experimental approaches to study cellular processes such as metabolism, cell signalling, cell division or apoptosis as well as cell dynamics. Depending on laser pulse energies manipulation levels can vary from stimulation to remodelling or even to complete ablation of cell structures.

Optical Perforation

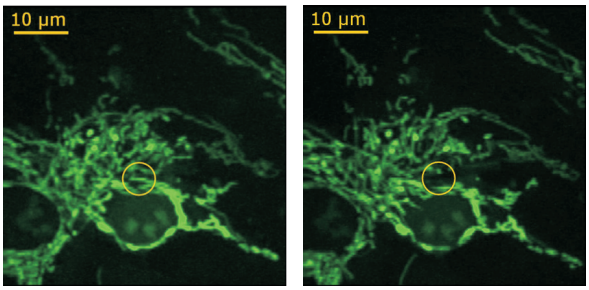
One possible application is the optical perforation of cell membranes to enable the transfer of genes into living cells. By focusing the laser beam for a few milliseconds on the membrane, transient pores are created so that nucleic acids and proteins can enter into the cell. Compared to conventional transfection techniques as the use of viral vectors, chemical carriers or electroporation, optical perforation considerably decreases the risk of cell damage.



ZMTH3 cells transfected with pEGFP-HMGA2 by optical perforation, right: fluorescence image, left: brightfield image, by courtesy of J. Baumgart, SFB/ Transregio 37, sponsored by the German Research Foundation

Nanosurgery

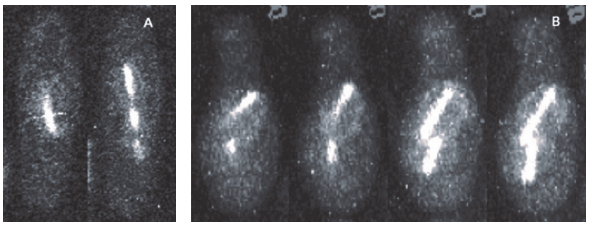
From optical knockout of specific cell organelles to dissection of single cytoskeletal filaments - the CellSurgeon allows very precise and reproducible nanosurgical operations. Dissection and ablation of subcellular structures do not affect surrounding structures.



Endothelia cell before (left) and after (right) ablation of a single mitochondrion, by courtesy of J. Baumgart, Laser Centre Hanover

Manipulation

The CellSurgeon is not only a nanodissecting instrument. Depending on the laser energy it is also possible to use the system for bleaching of labelled cell structures. A further potential application is the optical stimulation of cell organelles.



GFP-labelled mitotic spindles (fission yeast Schizosaccharomyces pombe), left: bleaching, right: cutting / ablation, by courtesy of I. Raabe, MPI of Cellular Biology & Genetics, Dresden

Technical Data

Costumized Configuration

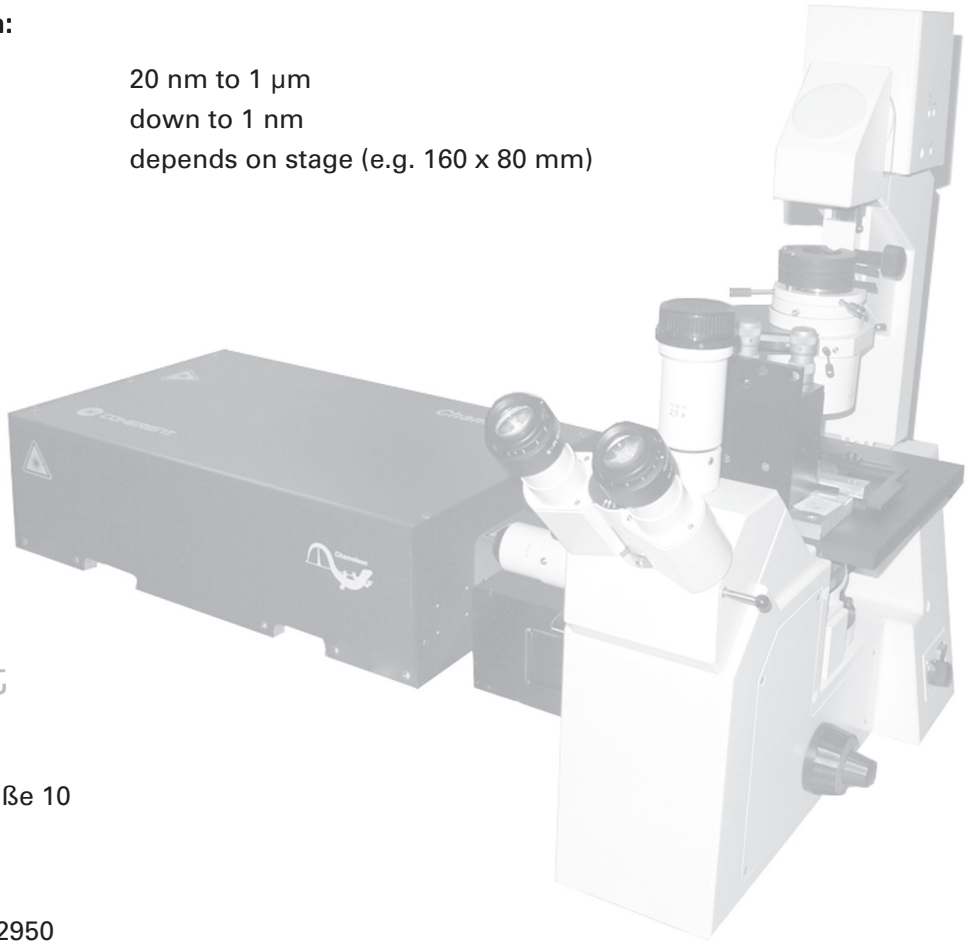
Rowiak offers customised configurations. Depending on your requirements different lasers, positioning systems and microscopes are available. It is also possible to adapt the CellSurgeon to microscopes and imaging procedures, already existing in your lab. Please contact us for more details!

Femtosecond laser:

- laser system: solid-state, tunable or single-wave
- repetition rate: 50 to 90 MHz (kHz and single pulse on request)
- pulse duration: typically 140 fs
- wavelength range: NIR (current configuration 720 - 950 nm, others on request)

Positioning system:

- resolution x/y: 20 nm to 1 µm
- resolution z: down to 1 nm
- travel range x/y: depends on stage (e.g. 160 x 80 mm)



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