ULTRASHORT FEMTOSECOND LASER MICROSCOPY
OF STEM CELLS

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Laser-assisted live cell manipulation based on multiphoton absorption of NIR light has great potential for high precision nanosurgery at various depths within cells and tissues. This non-contact method supports contamination-free cell surgery. Ultrashort laser pulses such as 10 fs near infrared pulses of a 85 MHz Ti:sapphire laser enable sub-100nm processing at low mean power (<10 mW) without collateral damage.

Here we demonstrate targeted transfection with a 12 fs laser microscope. In particular, transient pores in the cellular membrane were realized to transfect stem cells.

The successful integration of the foreign DNA and its protein expression 1-2 days after optical nanoinjection was probed with the same microscope but at low µW mean power by spectrally-resolved two-photon fluorescence lifetime imaging (two-photon spectral FLIM). Furthermore, spectral FLIM was employed to characterize cells after transfection.

We further aim to use this cutting-edge optical nanotechnology for optical highly efficient manipulation of stem cells for applications in the field of regenerative medicine.


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