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Technology Offer

Digital scanner

Ref.-No.: 0105-5505-BC

Light microscopy enables fascinating insights into the microcosm of life. It is one of the key techniques in life science and provides access to a better understanding of biology across many orders of magnitude in time and space. The use of visible light allows for minimally invasive imaging - even of living cells - and direct observation with the human eye. However, the use of visible light limits the resolution of the image obtained to about half the wavelength of the used light. The limiting diffraction barrier could be circumvented at the turn of this century by the introduction of stimulated emission depletion (STED) spectroscopy.

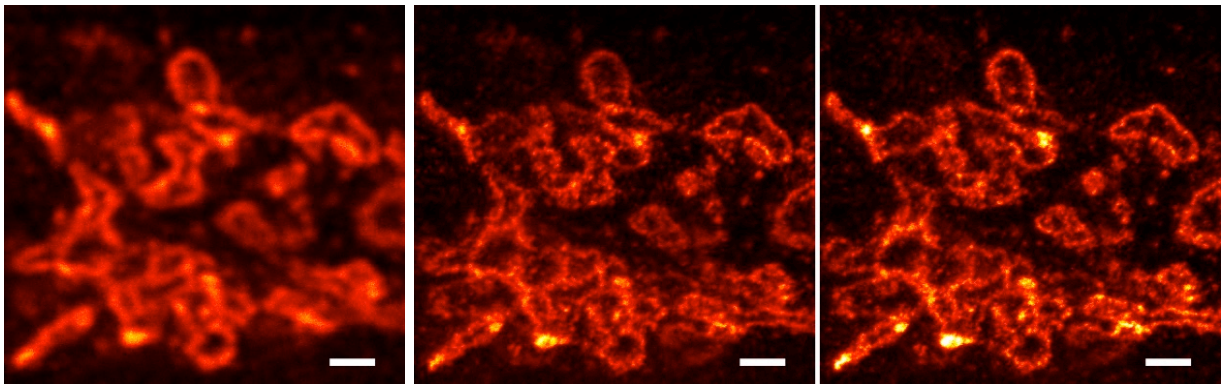
STED microscopy and various other microscopy techniques require the scanning of a sample with a light beam. Electro-optical deflectors (EODs) offer extraordinarily fast laser scanning speeds, high resolving powers, fast imaging and reduced photobleaching. However, two major shortcomings limit the widespread application of such devices: their polarizing properties prevent de-scanning causing either a loss in signal or an increase in background signal and the restricted deflection angles severely narrow the field of view.

Technology

With this technology, we offer a method of scanning a sample with a light beam focused by a microscope objective lens for super-resolution scanning fluorescence light microscopy techniques including STED and MINFLUX. The method implements an EOD to improve the scanning of a sample with a light beam at higher speed and precisions over an enlarged scanning range. Unlike a traditional galvanometer, which scans in milliseconds, the electro-optical scanner repositions within microseconds or even faster. Thus the EOD offers in the order of 1000-fold faster scanning capabilities than conventional galvanometer scanning.

Both shortcomings of EODs listed before are overcome. The polarization issue is evaded via a passive polarization rectifier that allows unpolarized light to pass through the laser scanner. The field of view is nearly doubled through a digital light deflector (DLD) composed of a Pockels cell and a Wollaston prism. Furthermore this same principle can be extended by N stages of the same kind, expanding the field of view by a factor of 2^N.

The relevance of the technology for biological and biomedical investigations is demonstrated through the imaging of the Golgi apparatus in fixed cells. Here the comparison between the mapped confocal DLD-EOD (left) and mapped DLD-EOD STED images, obtained using laser scanning (middle) and conventional galvanometers scanners (right) is shown (scale bar 1 µm).



Advantages

- Electro-optic laser scanner that allows for ultrafast laser scanning of large fields of view in two dimensions without significant shortcomings.
- The technology is compatible for application with confocal scanning fluorescence light microscopy and other scanning light microscopy techniques.

Patent Information

Patent application number EP 3 499 287 A1 filed on 2017.12.15

Literature Information

Marquard, J., 2018. *Digital Light Deflection and Electro-Optical Laser Scanning for STED Nanoscopy* (Doctoral dissertation).

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