Super-Resolution Microscopy for Live Cell Imaging (2017-048)

Super-Resolution Microscopy Enables Real-Time Live Imaging of Organisms Without Specialty Dyes

Market Overview

This method of super-resolution microscopy uses subtracted interleaved solid and doughnutshaped laser pulses to improve spatial resolution, resulting in real-time imaging of live microscopic organisms. The live cell imaging market has an estimated worth of $3.57 billion and is expected to grow due to increased government funding and the demand for high-content screening microscopy techniques in drug discovery. Conventional super-resolution microscopy requires high light dosage or special dyes to achieve improved spatial resolution, which can lead to damage in live cells during the imaging process. Clemson University researchers have developed a method of super-resolution microscopy using low power laser pulses that is compatible with an unrestricted menu of dyes or chromophores, allowing for imaging of live samples without causing damage to the cellular architecture. This innovative use of low power settings makes this technology promising for the future of biological research.

Technical Summary

In this method of super-resolution microscopy, interleaved solid and doughnut-shaped laser pulses are used to excite the biological sample, and the signal generated from each pulse is recorded. The signals between neighboring pulses are subtracted to effectively yield a shrunken point spread function, providing improved spatial resolution. The improvement factor is over two without deconvolution. This method uses only one laser at a single wavelength, which removes the need for high powered lasers used by other super-resolution microscopy techniques. The reduced power allows for imaging of live samples without damaging them. Low power pulsed lasers on the market cover a wide range of wavelengths, spanning from UV to near infrared. This allows for an unlimited selection of dyes or chromophores to use during the imaging process.

Application

Real-time, live cell imaging

Development Stage

Proof of Concept

Advantages

- Pulse-to-pulse deduction with multiplexed two modes of pulse illumination, improving spatial resolution at least twice over the diffraction limit
- Single wavelength laser is used, simplifying the equipment traditionally needed for super-resolution microscopy
- Lower excitation power compared to Stimulated Emission Depletion microscopy, preventing cell damage

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	62/482,251	NA	2017-048	Dr. Tong Ye

About the Inventor

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Dr. Tong Ye has a joint appointment in the Department of Cell and Regenerative Medicine at the Medical University of South Carolina. He earned his Ph.D. in Optics from Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences (CAS). He previously worked in the field of ultrafast spectroscopy and performed timeresolved spectroscopic studies on various biological chromophores in various institutes, including Institute of Chemistry, CAS, The Hebrew University in Jerusalem, and Duke University. In 2013 he started the Nano- and Functional Imaging Laboratory with the Clemson-MUSC bioengineering program located at Charleston, SC. His laboratory focuses on developing advanced technologies that can image cell and tissue functions with improved spatial and temporal resolutions and reduced phototoxicity.

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