Selective Plane Illumination for throughput three-dimensional time course imaging

Tech ID: 28785 / UC Case 2017-198-0

CONTACT

Casie Kelly-Quintos
casie.kelly@uci.edu
tel: 949-824-2920.

OTHER INFORMATION

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Imaging**
  - 3D/Immersive
  - Medical
- **Medical**
  - Imaging
  - Screening

RELATED CASES

2017-198-0

BRIEF DESCRIPTION

The invention is a novel arrangement that provides high throughput 3D time coursing imaging solution. The setup, simply applied to the conventional inverted microscope, not only improves the imaging speed, resolution and field view, but also provides new capabilities for monitoring a much broader range of samples with various thicknesses and nature. These features combined open new frontiers for imaging applications, including tracking the development of cells in tissues, one of the ultimate goals for imaging.

FULL DESCRIPTION

Selective Plane Illumination Microscopy (SPIM) proves to be a conventional and reliable candidate for fast three-dimensional imaging, with potential for high resolution imaging of cells and tissues. One of the key features for this technology is highly efficient image recording, significant depth penetration and reduced photo-bleaching. SPIM mainly utilizes two lenses; one for illumination and another for detection. Current SPIM arrangements require specific sample preparations, which unfortunately exclude the use of conventional sample mounts, such as coverslips, culture dishes and multi-well plates. In spite of the great potential that the SPIM technology can offer, currently followed approaches suffer from major drawbacks that need to be addressed. One popular approach is dipping the lens in the sample container so that they are both in the same fluid, while the other approach uses a light sheet generated by reflecting a beam incident from top using a small mirror. Dipping the lens in the sample container not only increases the container's size, but also eliminates the isolation between the optics and samples. Moreover, dipping from the top limits access from that direction. On the other hand, using the mirror imposes a need for precise positioning close to the sample, as well as risking mirror degradation because of the chemicals in the immersion fluid used. Such drawbacks impose major restrictions on the use of the SPIM technology, limiting the capabilities and potential that such technology has to offer.

Researchers at UCI devised an innovative method for high-throughput 3D imaging that addresses the drawbacks of conventional techniques. Their method includes a novel illumination technique, as well as a modified sample chamber design. Such modifications maximize the field of view, eliminate the need for dipping the lens in the sample container and provide appropriate isolation. Moreover, such new arrangement facilitates the use of a wider range of samples varying in nature, thickness and sealing. The modified camber design enables multi-well monitoring, in an automated manner that would yield an unprecedented throughput imaging solution. The devised method unleashes the capabilities and opportunities offered by SPIM technology, which would improve the imaging process features and ability to track samples' development with time in an accurate and fast manner.

ADVANTAGES

§ Easily applied to the conventional inverted microscope; older systems can be simply upgraded.

§ Broad range of samples can now be imaged; different nature, thicknesses and sealing type.

§ Use of high Numerical Aperture (NA) lenses is facilitated, which enhances the imaging sensitivity (down to single molecule)

§ Isolation of optics and samples is achieved, allowing imaging of sealed sample containers if needed

§ The new sample chamber facilitates the observation of multiple-wells simultaneously, in an automated, accurate and fast manner, which leverages the throughput of the device significantly.

§ All microscope ports remain available for other purposes

§ Field of view is maximized

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,385,451	07/12/2022	2017-198
United States Of America	Published Application	20220025314	01/27/2022	2017-198

STATE OF DEVELOPMENT

· Built and tested a prototype

· Verified that optical aberrations are minimal after introduction of the resin to match the refractive index

· Demonstrated that the design is compatible with 2-photon excitation

RELATED MATERIALS

» Hedde PN, Malacrida L, Gratton E. Selective Plane Illumination Microscopy in the Conventional Inverted Microscope Geometry. Biophysical Journal. 2017 Feb 3;112(3):145a. - 02/03/2017

» Hedde PN, Gratton E. Selective plane illumination microscopy with a light sheet of uniform thickness formed by an electrically tunable lens. Microscopy research and technique. 2016 Jun 1. - 06/01/2016

» Hedde PN, Gratton E. Fluorescence Anisotropy Imaging in 3D with Single Plane Illumination Microscopy. Biophysical Journal. 2016 Feb 16;110(3):482a. - 02/16/2016

UCI Beall Applied Innovation

5270 California Avenue / Irvine,CA
92697-7700 / Tel: 949.824.2683