**Wavelength-coded Multi-focal Microscope**
Technology #13942

**Applications**

This invention is a wavelength-coded multi-focal microscope that has the ability to obtain biological tissue structures simultaneously at different focal planes using broadband illumination by LED.

**Problem Addressed**

Microscopic imaging systems are beneficial for biomedical and clinical applications. Three dimensional microscopic imaging systems, such as confocal microscopy and optical coherence tomography (OCT) have been developed to detect tissue structures within biological samples. Both confocal microscopy and OCT require mechanical, opto-electronic, or acousto-optic scanning in two lateral and axial dimensions. Volume holographic multiplexing (VHM) has been developed to eliminate the need for mechanical scanning. In VMH, holographic gratings are superimposed in a volume recording material such that each grating obtains depth resolved information from different depths within the object. However, if the object is illuminated by a spectrally broadband source, contrast is reduced, because colors originating at multiple depths cannot be separated because of the degeneracy properties of the hologram. Thus there is a need to create a microscope that can simultaneously obtain information from multiple depths and specific colors corresponding to each depth within biological samples without scanning.

**Technology**

This invention is a wavelength-coded multi-focal microscope incorporating multiplexed and wavelength-coded holographic gratings to generate wavelength selective multi-focal planes. The microscope is comprised of an objective lens for receiving electromagnetic radiation from an object of interest; a volume hologram to receive and diffract collimated electromagnetic radiation from the objective lens; and a focusing element which focuses the collimated electromagnetic radiation passing through the hologram, onto an imaging plane. Wavelength-coded holographic gratings multiplexed with a volume hologram can be carried out using a single wavelength, which offers simple setup since no multiple or tunable lasers are required. This microscope can obtain biological tissue structures simultaneously at different focal planes using broadband illumination. Compared with previous holographic imaging systems, in this approach, specific wavelengths can be designated to beneficial locations within the object. For example, longer wavelengths can obtain deeper information within tissue objects, because these wavelengths have longer penetration depth. In addition, this device provides freedom to tune the brightness and contrast at different focal planes by independently varying the intensity of mutually incoherent light sources. Furthermore, this wavelength coded multi-focal microscope can be used to monitor spectrum properties of biological tissue structure, for example, it can monitor spectrum shift and fluorescence intermittency due to chemical reactions or interactions.

**Advantages**

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• Displays multiple depths within an object
• Projects non overlapping images obtained from biological/tissue structure
• Monitors spectrum properties of an object

Categories For This Invention:
Life Sciences
Instrumentation
Microscopy

Intellectual Property:
System, method and apparatus for wavelength-coded multi-focal microscopy
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Wavelength-coded Multifocal Microscopy
Optics Letters
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External Links:
BioSystems and Micromechanics (BioSyM) Inter-Disciplinary Research Group

Image Gallery: