High Resolution Optical Coherence Tomography Over A Greater Depth Range Using An Axicon Lens

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BRIEF DESCRIPTION

In optical coherence tomography (OCT), Axial and lateral resolutions are determined by the source coherence length and numerical aperture of the sampling lens, respectively. While axial resolution can be improved using a broadband light source, there is a trade-off between lateral resolution and focusing depth when conventional optical elements are used. The incorporation of an axicon lens into the sample arm of the interferometer overcomes this limitation. Using an axicon lens with a top angle of 160 degrees, 10 μm or better-lateral resolution is maintained over a focusing depth of at least 6 mm. In addition to high lateral resolution, the focusing spot intensity is approximately constant over a greater depth range.

FULL DESCRIPTION

The invention is an improvement in a scanning OCT system, which includes an interferometer with a sample arm for scanning a sample. The improvement comprises an axicon lens disposed in the sample arm to simultaneously achieve high lateral resolution and a greater depth of focus of the sample. The axicon lens in the sample arm is provided with spatially coherent light. In the illustrated embodiment the axicon lens comprises a single refracting cone lens, but it may assume any other form desired such as a ring lens or a cylindrical lens.

More specifically, the invention is an improvement in an apparatus for phase-resolved optical tomography capable of simultaneously imaging fluid flow and morphology in a sample with fast scanning speed and high velocity sensitivity. The apparatus comprises an interferometer; a source of at least partially coherent radiation through coupled to the interferometer in which the at least partially coherent radiation is characterized by a phase; a phase modulator coupled to the source to modulate the radiation in the interferometer at a modulation frequency; and a scanner for scanning the sample with the source of at least partially coherent radiation through the interferometer in a sequence of pixel line scans. The sample has a fluid flow therein so that the phase of the partially coherent radiation is changed in response to the fluid flow at each pixel of each pixel line scan. A detector detects interference fringes of the radiation backscattered from the sample into the interferometer. A processor determines the corresponding phase at each pixel of the pixel line scans from the ODT phase signals of the detected backscattered interference fringes and compares the phase between corresponding pixels in two line scans to generate a difference between the phase at the two corresponding pixels in two line scans. A display generates a tomographic image of the fluid flow in the sample from the difference at each pixel. The improvement comprises an axicon lens disposed in the sample arm to simultaneously achieve high lateral resolution and a greater depth of focus of the sample.

Full details can be found in patent no. 7,072,045.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,072,045	07/04/2006	2002-208

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OTHER INFORMATION

CATEGORIZED AS

- » **Optics and Photonics**
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