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Nondestructive 3D Characterization of Materials Using Optical Coherence Tomography

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Optical Coherence Tomography (OCT) is an optical imaging technology that produces cross-sectional image similar to that obtained by Ultrasound imaging but at much higher resolution, higher imaging speed, and higher sensitivity. Unlike other optical microscope, OCT utilizes low-coherence properties of the broadband light source to gate the sample's microscopic structure over depth and hence is capable of noncontact and non-destructive three dimensional (3D) mapping of sample's structure. Moreover, utilizing the principle of light interference in the frequency domain, our custom developed OCT systems is capable of imaging speed of more than 100 frames per second. This high speed imaging capability allows for three dimensional (3D) imaging in less than 10 seconds, which is useful for nondestructive monitoring of micro structures of samples in 3D and in real time. Here, we report the progress on the development of several techniques of nondestructive metrology using OCT system, such as surface topography, thickness topography, refractive index profilometry, 3D flow velocity mapping, 3D elasticity measurement, and polarization sensitive characterization. Furthermore, several approaches to push the limit of OCT for 3D characterization of nanomaterials will be presented and discussed.

Keywords: Optical tomography, 3D imaging, Thickness topography, Elastography, Birefringence map, flow analysis

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