Novel Nanoscale Confocal Microscopy: Principles and Applications

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3D surface metrology with a nanoscale precision in the depth direction has attracted much physical, chemical, biological or even industrial interest because the technology can really observe some novel pheonemons, such as thermal-related micro-deformations in cell wall or opto-electronic devices, the surface area for reactions or the surface roughness producing the friction forces.

In our work, we first demonstrate a novel nanoscale confocal microscopy by the combinations of chromatic aberrations, the diffraction gratings, and the position sensitive detectors. The reflection spectrums from different depths varies by the chromatic aberrations and the various spectrum is then dispersed in space by gratings and the locations of the dispersed spectrums were then detected by the position sensitive detectors. Despite the advantages of the nanoscale resolutions in the depth resolution, the full 3D surface morphology or even the interface morphology can be recorded by a single 2D scan [1].

In the conference, we will also present some applications of the confocal microscope. First, we use the microscope to monitor the 3D surface roughness of opto-elctrical devices or optic devices to visualize the quality of surfaces. Second, we will show that the dynamic thermal lensing effects (including the thermal expansion and contractions) can be noninvasively monitored and the damping behaviors in the refractive index can thus be monitored. Third, we can use the advanced confocal microscope to see the time-dependent ion diffusion in the light electro-chemical cells without destructing the devices. Finally, we can use the polarization-dependent version of the nanoscale confocal microscope to see the nanoscale bire-fringences in the liquid crystal cells. More detailed contents will be shown in the conference.

Reference

[1] G. –Y. Zhuo, C. H. Hsu, Y. –H. Wang, and M. –C. Chan, " Chromatic confocal microscopy to rapidly reveal nanoscale surface/interface topography by position-sensitive detection,"Appl. Phys. Lett. 113, 083106 (2018).