HIGH RESOLUTION TOMOGRAPHIC DIFFRACTIVE MICROSCOPY OF TRANSPARENT SAMPLES

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We have built a tomographic diffractive microscope [1,2], based on the Wolf approach [3], and constructed similarly to Lauer's implementation [4]. First, one illuminates the object with a succession of plane waves of controlled incidence. The amplitude and phase of both the illumination and the scattered waves are recorded using phase-shifting holography. The second step consists in a numerical reconstruction by retropropagating the various front waves and recombining them (diffractive tomography), within the first Born approximation [5].

The illumination (λ=633nm) and the detection are performed through high numerical aperture (NA=1.4) condenser and objective, respectively. The setup has been built onto an Olympus IX71 inverted microscope, and coupled to an Olympus FV 300 confocal scanner. Figure 1 compares images of a lacey carbon film obtained with several microscopy techniques, and has served to demonstrate a 130 nm lateral resolution or $\lambda/3.5$. This instrument is therefore characterized by its high spatial resolution [6] and also by its high sensitivity to small index of refraction variations, thus paving the way for high resolution imaging of unlabelled transparent specimens [6,7].

The resolution of such a microscope remains however limited along the optical axis [6], which, (as for tomography with object rotation [8]), may have consequences on both the object's shape and refractive index distribution reconstructions. We discuss possible approaches to obtain an isotropic high resolution for true 3-D imaging.

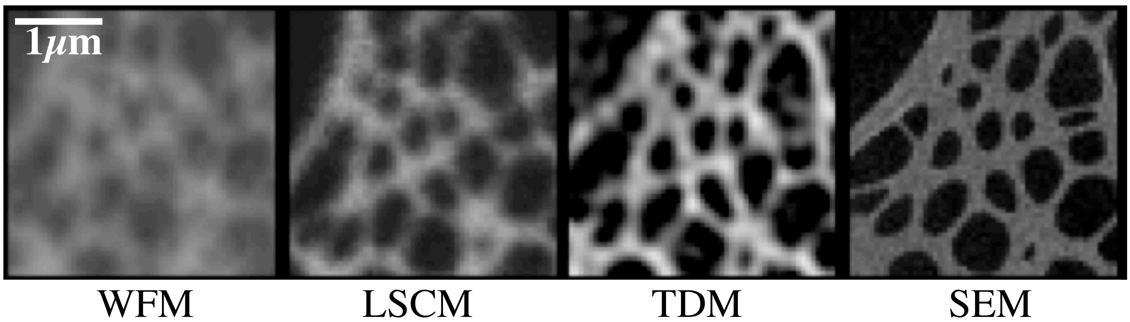

Figure 1: Images of a lacey carbon film obtained through (from left to right): wide-field microscopy, fluorescence confocal microscopy, tomographic diffractive microscopy, and scanning electron microscopy, which serves as a reference.

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