

# WIDE-FIELD DIGITAL HOLOGRAPHIC MICROSCOPY VIA SPATIAL FOURIER SPECTRAL SYNTHESIS

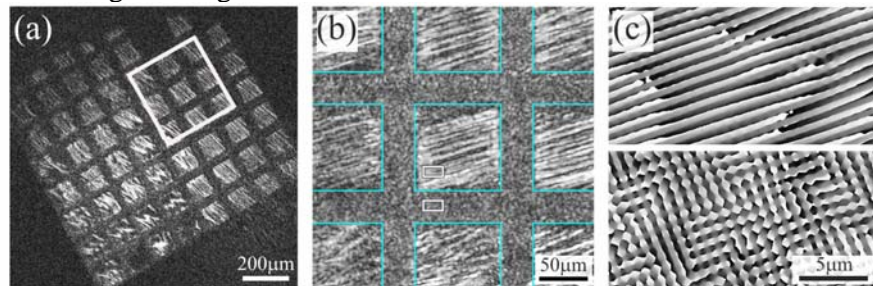
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**KEY WORDS:** Digital holographic microscopy, Fourier holography, synthetic aperture

High-numerical aperture (NA) objectives usually restrict the field of view and working distances of high resolution microscopy. To address these restrictions, we have developed a new coherent imaging technique capable of forming images with sub-wavelength resolution with large (millimetre-scale) fields of view at long (centimetre-scale) working distances [1]. Fourier holograms of different regions of the object's complex spatial Fourier spectrum are recorded and the full Fourier spectrum is synthesised so that both amplitude and quantitative phase images of the original object can be reconstructed digitally. Different regions of the Fourier plane can be selected by changing the spatial and/or spectral properties of the illumination beam. Altering the collection and solid angles also affects the captured range of frequencies. The imaging lens is a low-NA objective which provides a long working distance and a wide field of view with low aberrations. Due to the fact that the complete complex sample field is acquired, digital post-processing procedures (e.g., refocusing or aberration correction) can be performed. This unique combination of features enables high-resolution images to be obtained for both flat and non-planar objects even if they are embedded in thick semi-transparent media. Phase information can be used for three-dimensional reconstruction of the object surface. In this presentation we will demonstrate synthesised images of different objects with resolution several times higher than that of the optics used, obtained with a wide field of view and long working distance.



In the figure, part (a) shows a reconstructed image of a TEM target, part (b), a magnified selected area of the image, and (c), magnified phase images of the selected boxes in (b). The fine structure of the target, with a period of approximately three times lower than the resolution limit of the optics used, can be clearly seen in the magnified fragment of the TEM target image.

[1] S. A. Alexandrov, T. R. Hillman, T. Gutzler, and D. D. Sampson, "Synthetic aperture Fourier holographic optical microscopy", *Phys. Rev. Lett.*, vol. 97, no. 16, 168102, 2006.