Synthetic Optical Holography for Rapid Optical Nanoimaging

M. Schnell[1], P. S. Carney[2] and R. Hillenbrand[3,4]

[1]CIC nanoGUNE, 20018 Donostia-San Sebastian, Spain
[2]Department Electrical and Computer Engineering and The Beckman Institute for Advanced Science and Technology, University of Illinois, Urbana, Illinois 61801,USA
[3]CIC nanoGUNE and UPV/EHU, 20018 Donostia – San Sebastian, Spain
[4]IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain

schnelloptics@gmail.com

We demonstrate a novel holographic method, termed synthetic optical holography (SOH) [1], for fast phase imaging in scanning near-field optical microscopy (s-SNOM). The holographic principle of phase detection enables fast near-field imaging with unprecedented speed, allowing for the acquisition of standard sized (256 x 256 pixel) near-field images in 26 seconds and megapixel images in less than 15 minutes. At the same time SOH offers technical simplicity as only a linearly moving reference mirror needs to be added to an existing near-field microscope setup.

We apply the fast phase imaging capabilities of SOH to nanoscale, noninvasive and rapid screening of grain boundaries in CVD-grown graphene, by recording 2.3 megapixel near-field images in only 13 minutes. The images (Fig. 1) reveal a network of grain boundaries [1], owing to the large reflection of tip-induced graphene plasmons [2,3] at the grain boundaries [4]. Study of the near-field phase contrast directly reveals the propagating nature of graphene plasmons, which might benefit the quantitative analysis of plasmon interference phenomena. Noninvasive and rapid near-field mapping of graphene grain boundaries and defects could benefit the optimization of growth process and quality control.

References

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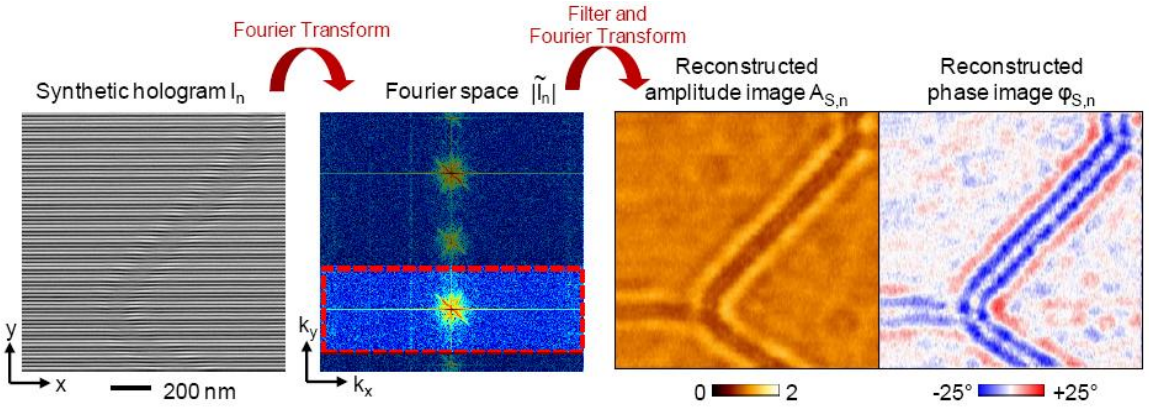

Figure 1. Reconstruction of near-field amplitude and phase images (right) of a graphene grain boundary from a synthetic near-field hologram (left, 256 x 256 pixel), which was recorded in only 26 s.