Unraveling the 3D atomic structure of a suspended graphene/hBN van der Waals heterostructure - Supporting information

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MAADF - HAADF comparison

Fig. 1 shows a MAADF (left) and a HAADF (right) image of a portion of the heterostructure. The two images were acquired simultaneously. The MAADF image shows a remarkable variation of intensity across the moiré unit cell that allows for identification of the differently stacked regions. In contrast, the HAADF image has a constant brightness that prevents such identification. For this reason, MAADF imaging was preferred over HAADF in this work.

Custom aperture

The custom aperture is shown in Fig. 2 and it consists of a regular 3 mm diameter TEM grid (200 mesh gold grid) onto which a 400 µm diameter, 1µm thick Cu disc was fabricated.

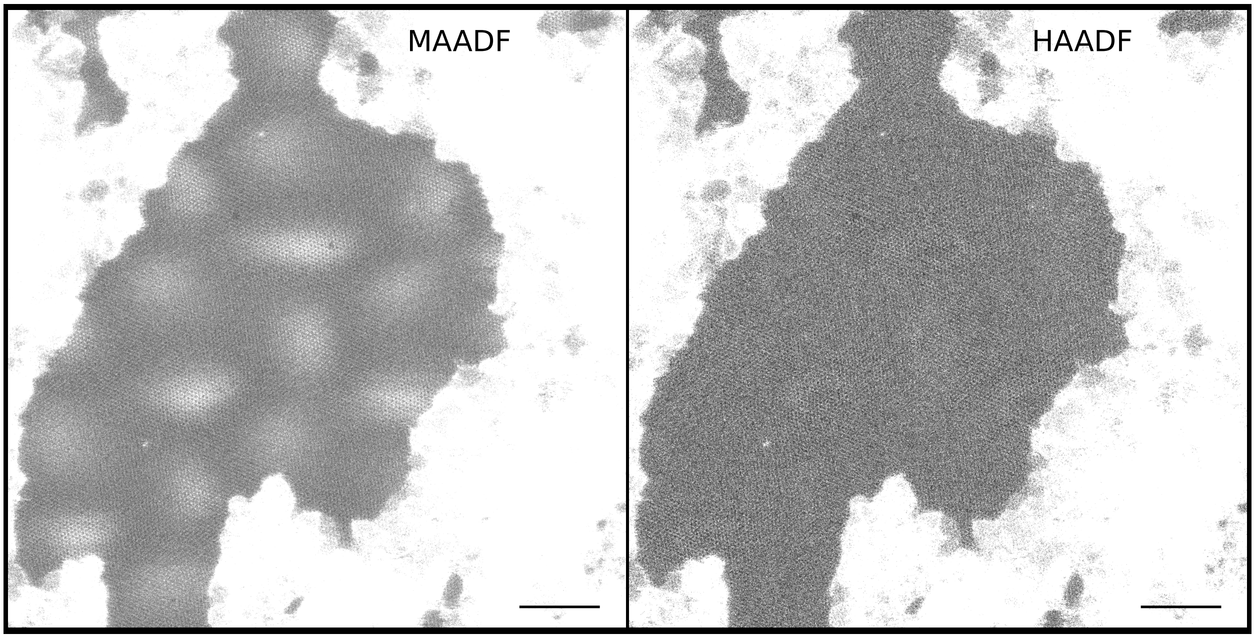

Figure 1: Comparison between MAADF (left) and HAADF (right) imaging of the same area of the heterostructure. The images shown are raw data. Scale bars are 5 nm.

The structure was made as follows: a 1 µm thick Cu layer was thermally evaporated through a hollow mask (400 µm diameter hole) onto a TEM grid coated with a continuous thin amorphous carbon, to produce a Cu disk with a 400 µm diameter. After the deposition, the carbon foil was removed using plasma etching, leaving the Cu disk suspended on the grid bars. The aperture was then inserted into the STEM in one of the slots dedicated to EELS apertures.

Simulation details

All STEM simulations were performed with the QSTEM software. The beam energy was set to 60 keV and all aberrations were set to zero. The convergence half-angle of the beam was 25 mrad. The pixel size in the simulation was 0.3 Å and a blur of 3 pixels was applied in order to account for the finite source size. We performed simulations with and without thermal diffuse scattering (TDS) at 300 K and we did not observe any significant difference in our findings for the two cases. The "save level" of the software was increased from the default value of 0 to 1 in order to save the diffracted intensity image for each scanned pixel.

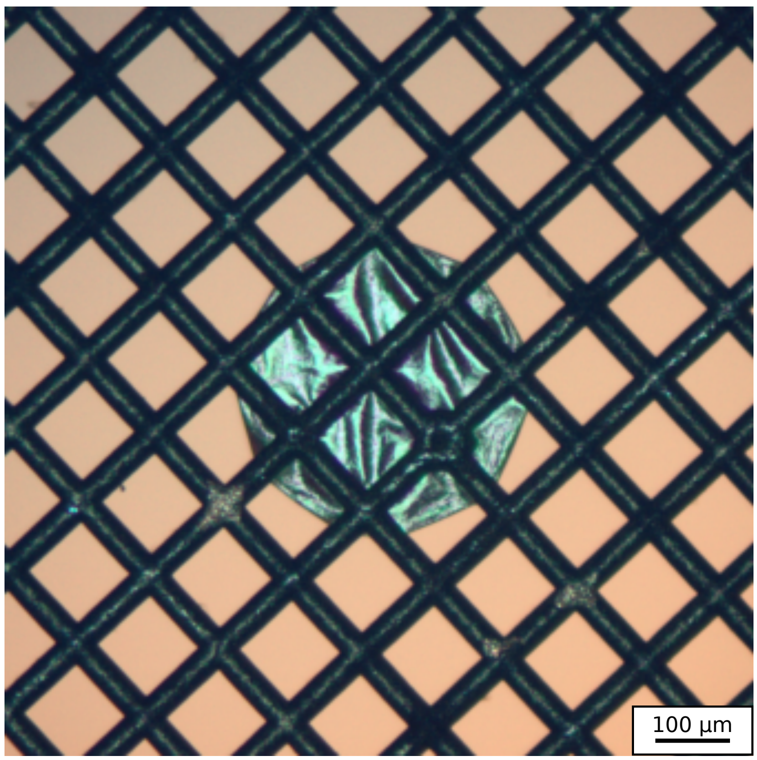

Figure 2: Optical micrograph of the custom aperture used in the experiments. The copper disk, used to block the bright field disk, is well visible at the center of the image.