Direct nucleation of hexagonal boron nitride on diamond: Crystalline properties of hBN nanowalls

Supplementary material

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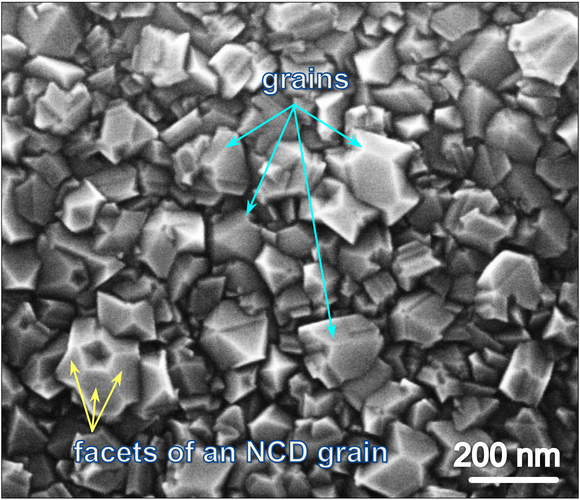

Figure 1 SEM image of the 300 nm-thick NCD film grown on a Si(100) substrate showing well-faceted grains.

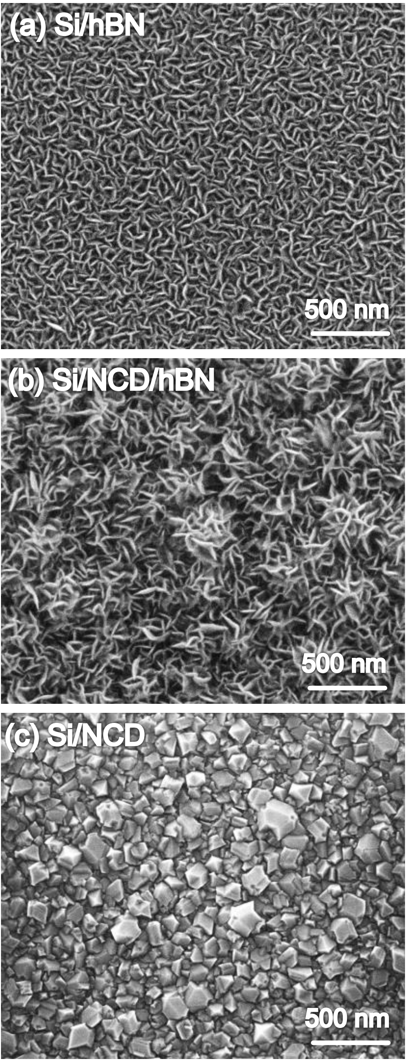

Figure 2 SEM images of (a) sample T1, a 300 nm-thick hBN nanowall film deposited on a Si(100) substrate (b) T2, a 300 nm-thick hBN nanowall film deposited on a NCD film (c) the 300 nm-thick NCD film prior to the hBN deposition.

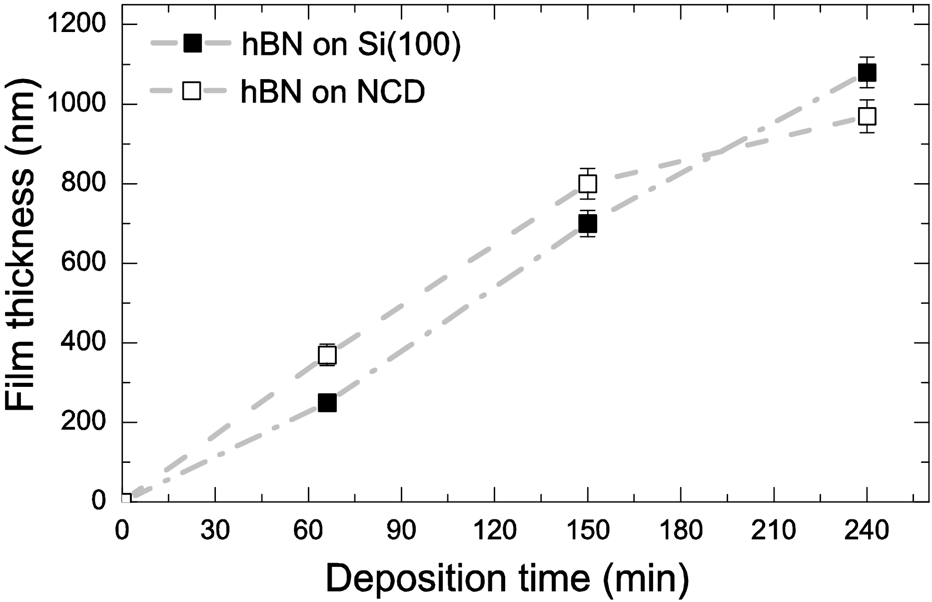

Figure 3 Thicknesses of hBN films deposited on Si (100) and NCD substrates as a function of deposition times. Each point represents a single deposition with error bars computed independently for each film, as the standard deviation for the measurement of 10 different points in the cross-sectional SEM images used for thickness determination.

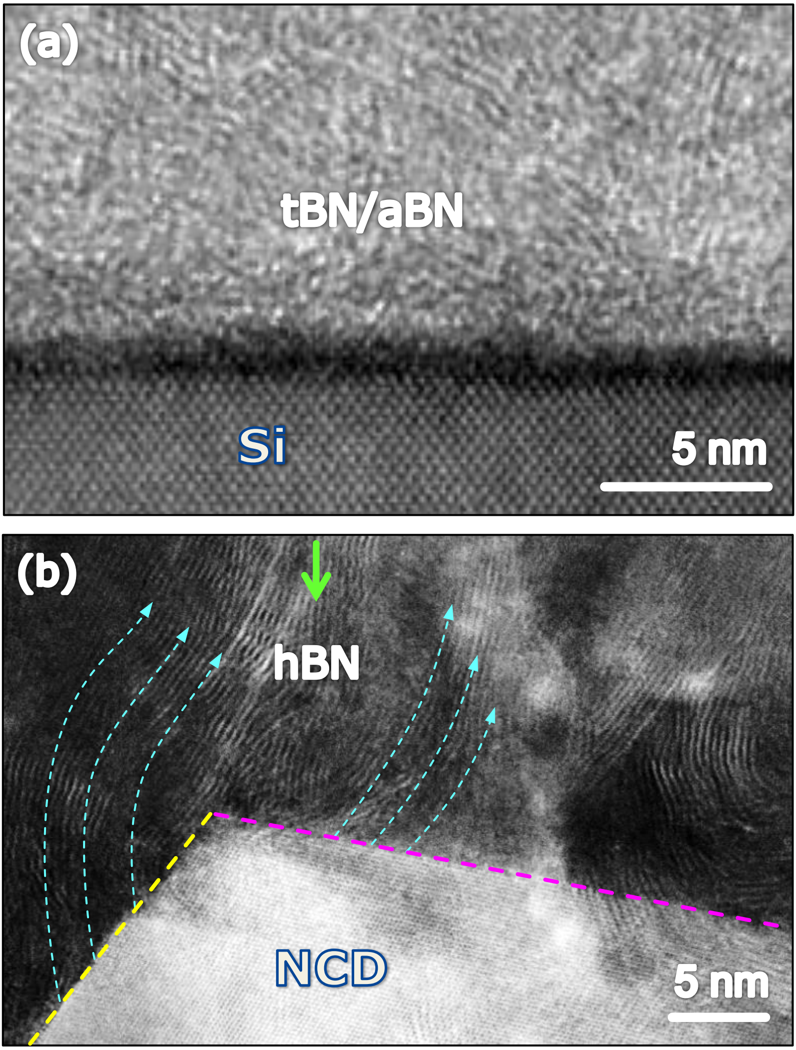

Figure 4 (a) A HR TEM image of the interface between the Si substrate and BN material showing turbostratic and amorphous BN phases. (b) ADF STEM image of the interface of the NCD substrate and hBN film, showing high crystallinity and the presence of the hBN phase starting directly at the interface with diamond. Cyan dashed-arrows indicate typical hBN nanosheets that nucleate and grow directly from the facets of the NCD grain.

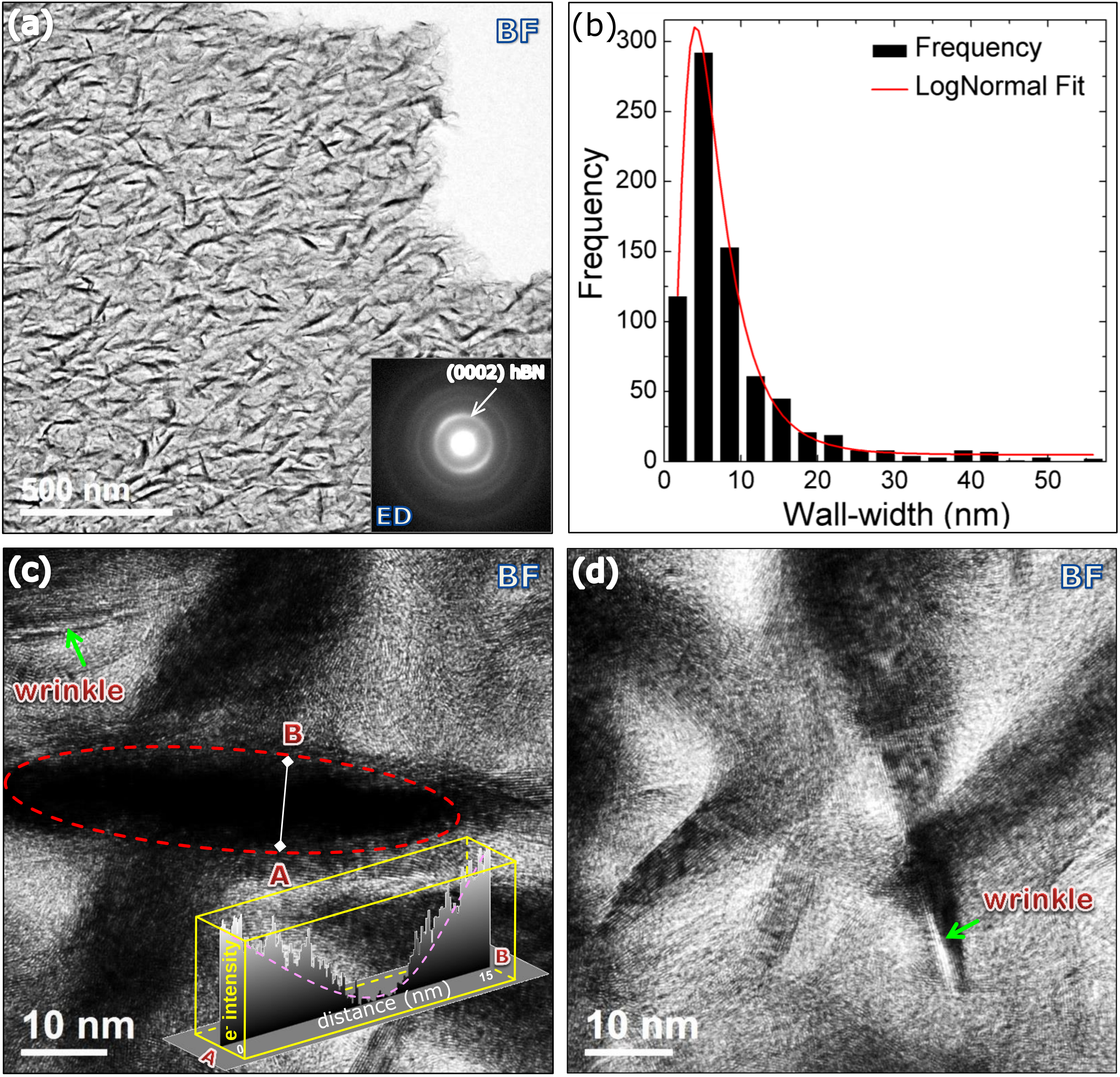

Figure 5 (a) A BF TEM image of a 100 nm-thick hBN film deposited on a Si_3N_4 membrane (sample T3). The inset is an ED pattern taken in the same region. (b) The width distribution of the walls determined from (a) (see text). (c) and (d) BF HRTEM images recorded from two representative areas from the area shown in (a), with well-defined (c) and more defective (d) nanowall profiles. The inset in (c) is an electron intensity profile that was extracted from A to B connecting two sides of the nanowall circled in the dashed ellipse.

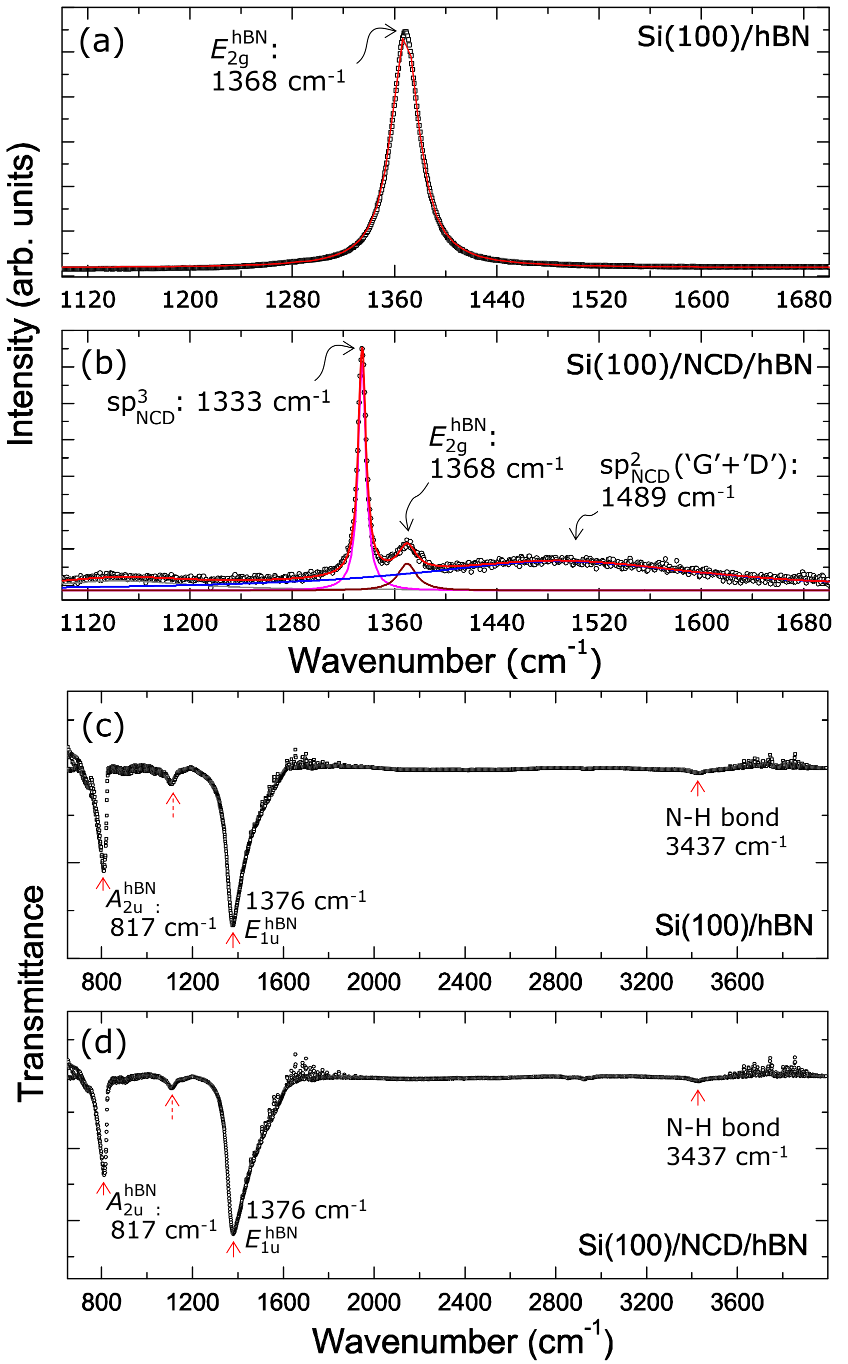

Figure 6 (a) Raman spectrum for sample T1 (b) Raman spectrum for sample T2 (c) FTIR transmittance spectrum for sample T1 (d) FTIR transmittance spectrum for sample T2. The red solid lines showing in (a) and (b) are the best fits for those Raman spectra. The other colored lines in (b) are three different characteristic peaks associated diamond and hBN films.

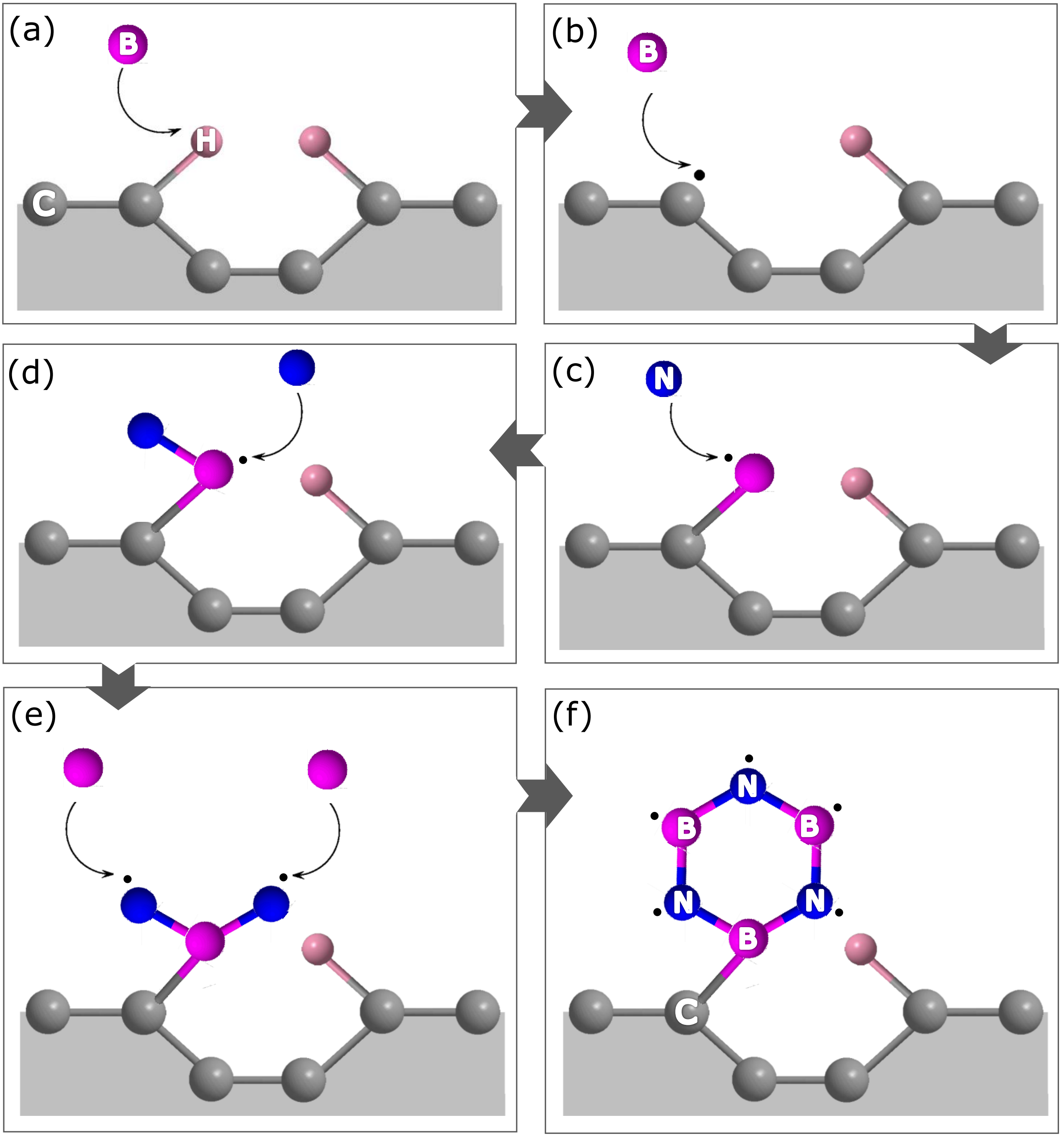

Figure 7 Schematic illustration of the nucleation of a crystalline hBN nanosheet on a H-terminated diamond surface: (a-b) a sputtered B-ion abstracts and replaces the H-atom at the H-terminated diamond surface; (c-d) sputtered N ions bond to the resulting B sites; (e) sputtered B-ions bond with the resulting N-sites; (f) a sputtered N ion bonds to both of the resulting B sites to form a complete hBN ring, which nucleates the nanosheet.