Diaphite: diamond-graphene hybrid nanostructures grown in $CH_4/H_2/N_2$ chemistry

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ABSTRACT

Supplementary Information

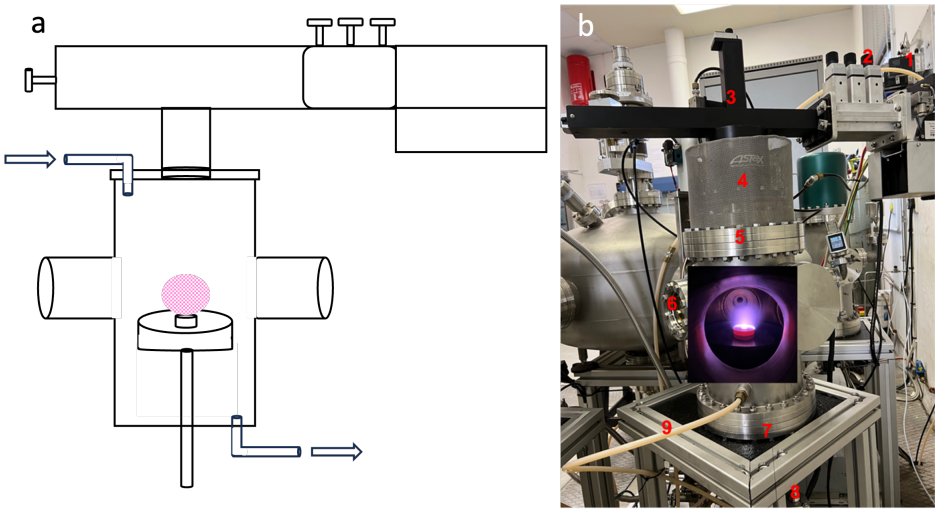

Figure 1. Custom-built MPECVD reactor at NSTPL: a) Schematic picture of self-assembled MPECVD system. b) MPECVD with different parts including a (1) MKS solid state Microwave generator, (2) Sub tuner, (3) Waveguide with applicator, (4) antenna connecting the waveguide and CVD chamber, (5) a transparent quartz window is placed between the antenna and the CVD chamber, (6) CVD main chamber with substrate stage and holder, (7) Stage height adjustor, (8) Vacuum line, and (9) Water circulation line.

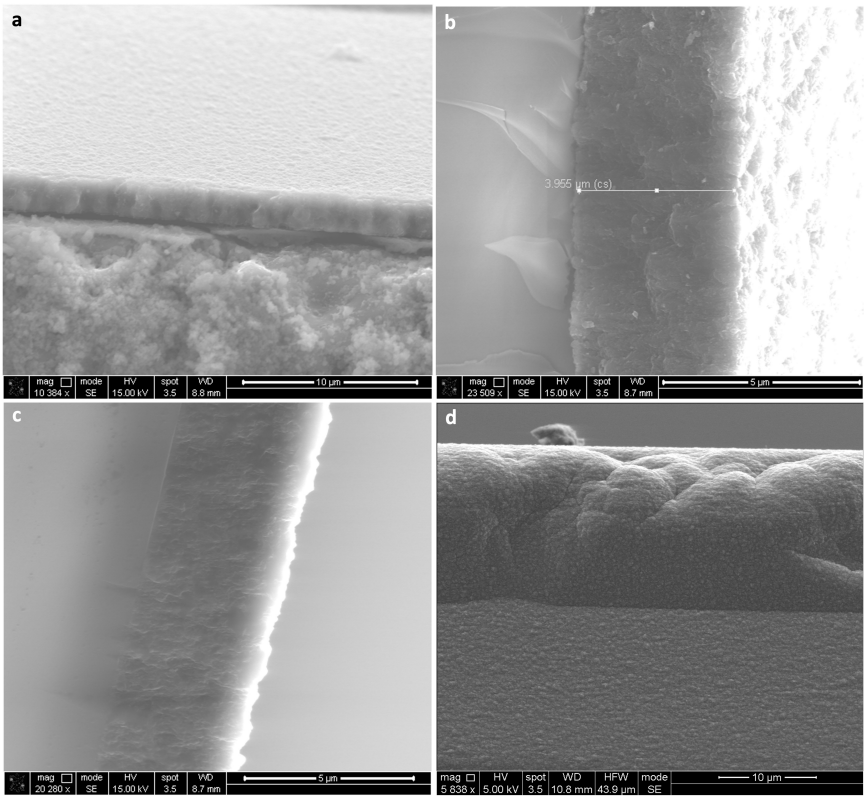

Figure 2. Cross sectional images of N_2 doped UNCD samples. a) $UNCD_5$ of film thickness 3.5 ± 0.1 μm. b) $UNCD_{10}$ of film thickness 3.9 ± 0.1 μm. c) $UNCD_{15}$ of film thickness 5.2 ± 0.2 μm. d) $UNCD_{20}$ of film thickness 7.1 ± 0.2 μm.

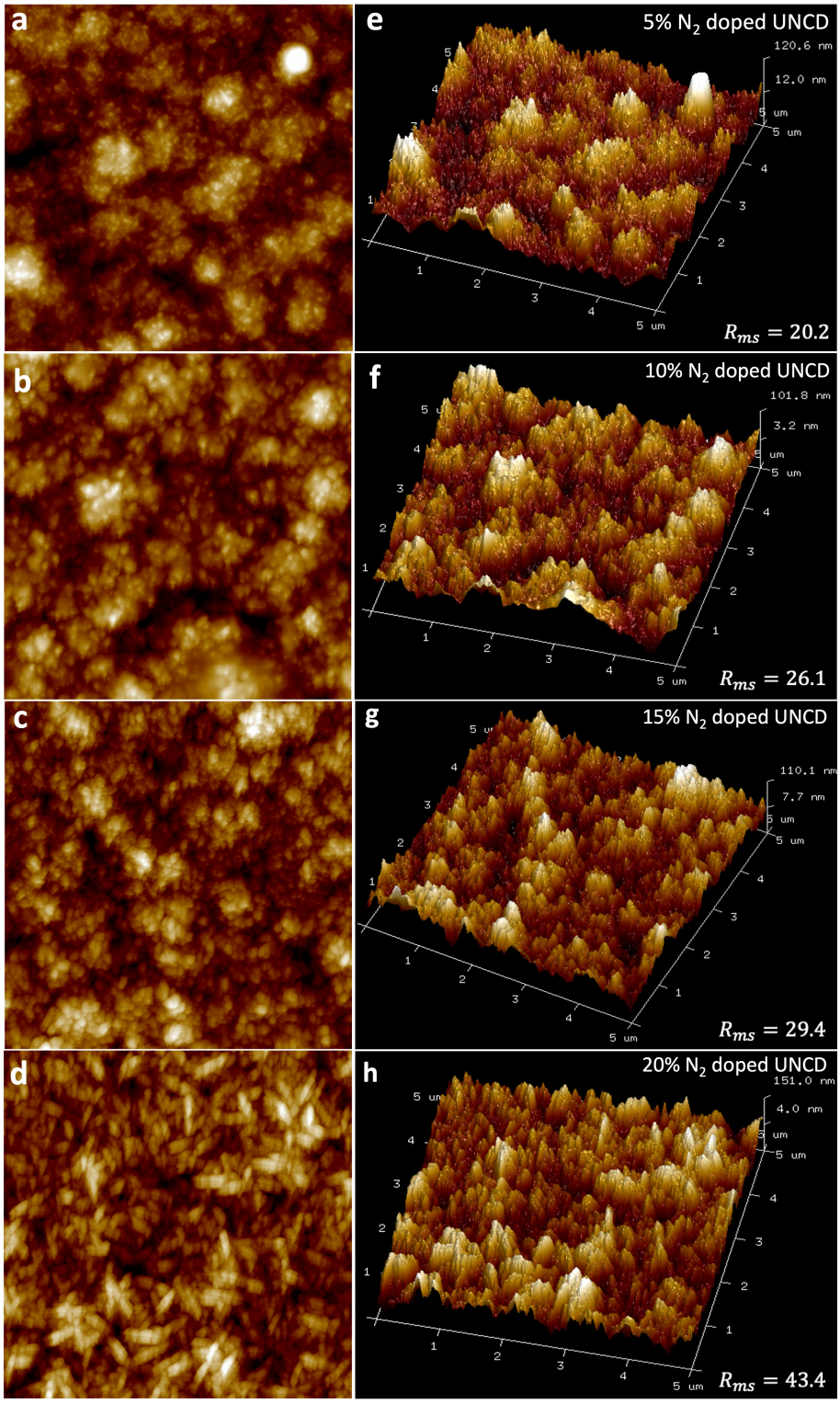

Figure 3. Atomic Force Microscopy (AFM) investigation of UNCD as a function of N2 doping. a, b, c, and d) AFM height senor non-contact mode imaging of 5%, 10%, 15% and 20% N_2 doped UNCD samples. e, f, g, and h) are the 3 D mapping of the surface terrain of the respective samples. It can be noted that R_{ms} values increase as the N_2 doping is increased.

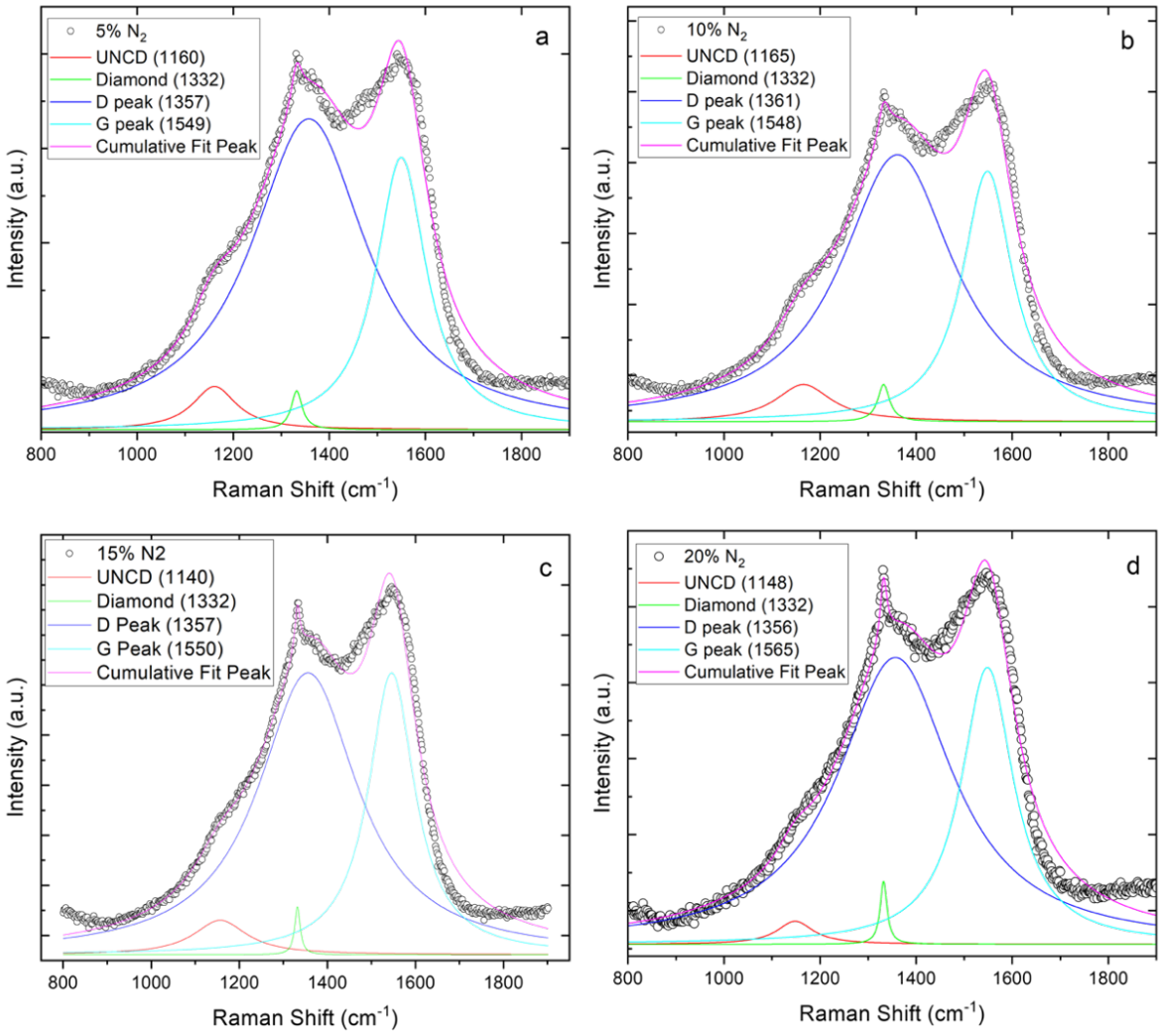

Figure 4. Deconvoluted Raman Spectra of UNCD samples with varied N_2 concentration. a) $UNCD_5$, b) $UNCD_{10}$, c) $UNCD_{15}$, and d) $UNCD_{20}$ sample.

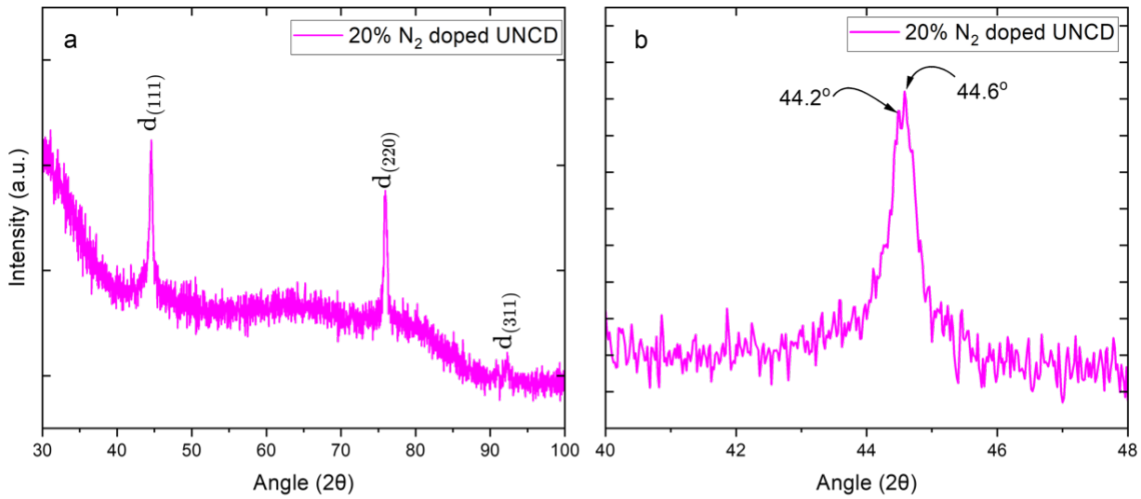

Figure 5. XRD plot of $UNCD_{20}$. a) Commonly observed $d_{(111)}$, $d_{(220)}$ and $d_{(311)}$ diffraction associated with d spacing 0.206 nm, 0.126 nm and 0.107 nm respectively. b) The $d_{(111)}$ peak for $UNCD_{20}$ shift to higher Braggs angle compared to $UNCD_5$ and $UNCD_{10}$ samples.

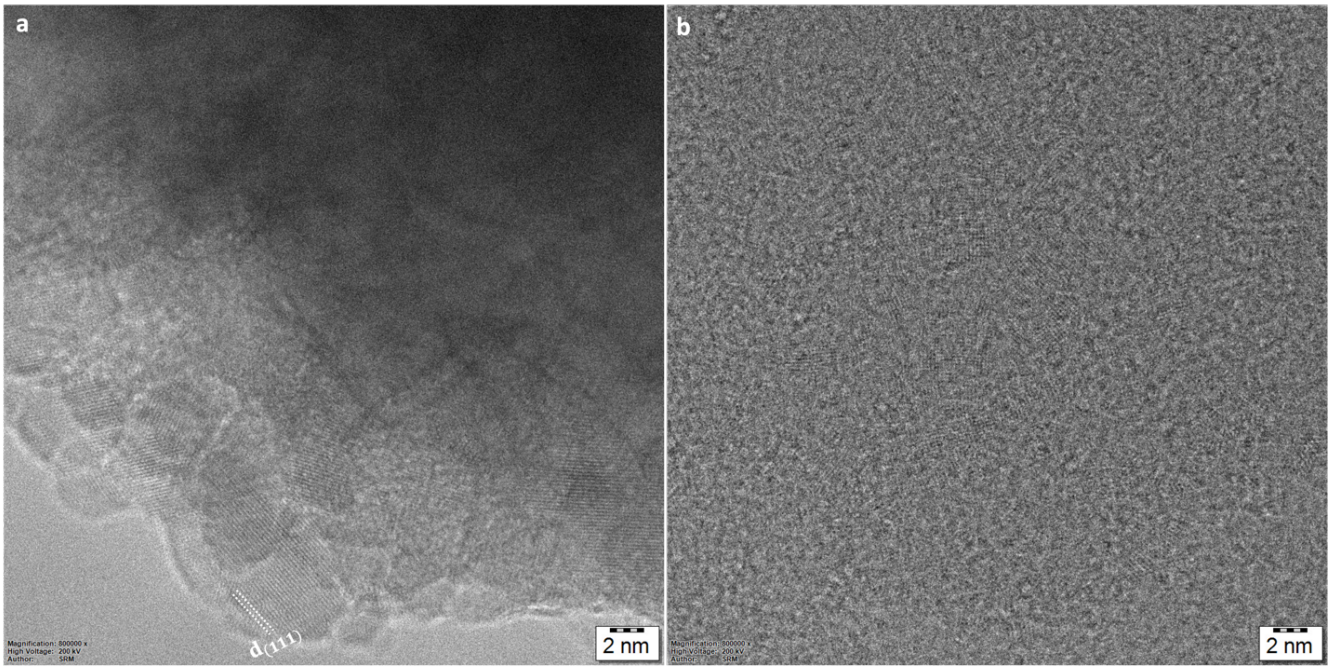

Figure 6. HR-TEM image of UNCD with no doping. a and b) nanodiamond display only {111} fringes associated with cubic diamond.