Supplementary Materials

Effect of the growth interruption on the surface morphology and crystalline quality of MOCVD-grown h-BN

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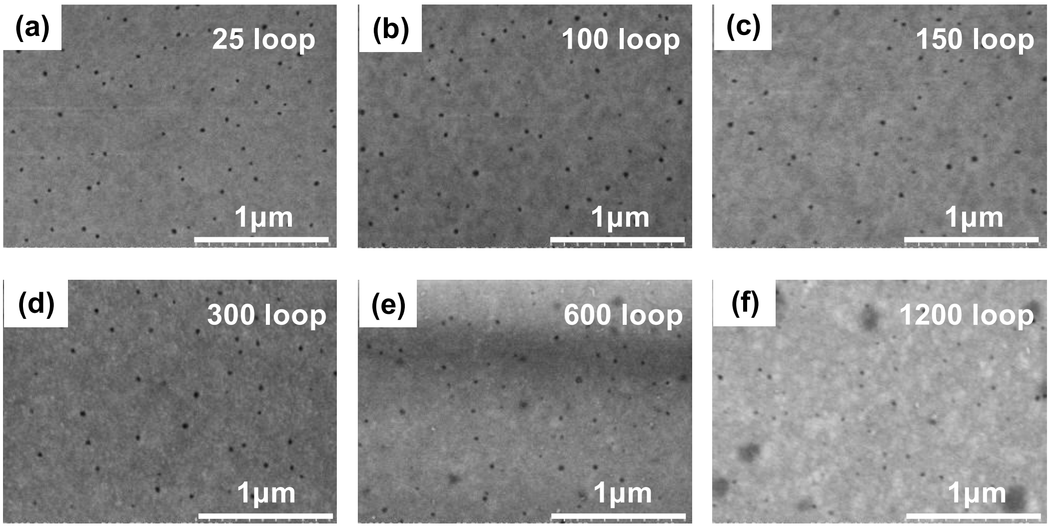

Figure S1 The surface morphology variations of h-BN films grown by NH_3/TEB with the growth loops.

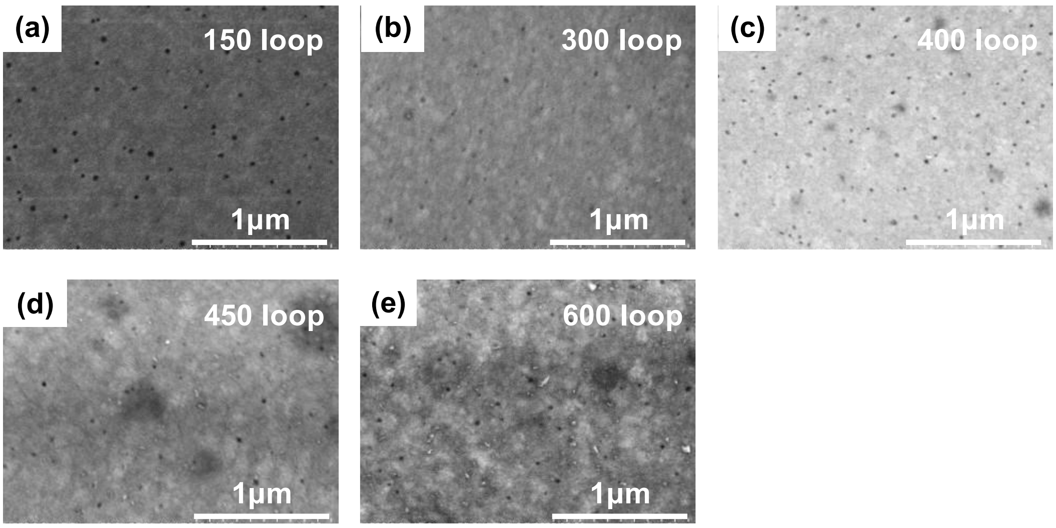

Figure S2 The surface morphology variations of h-BN films grown by NH_3/Itrp/TEB with the growth loops.

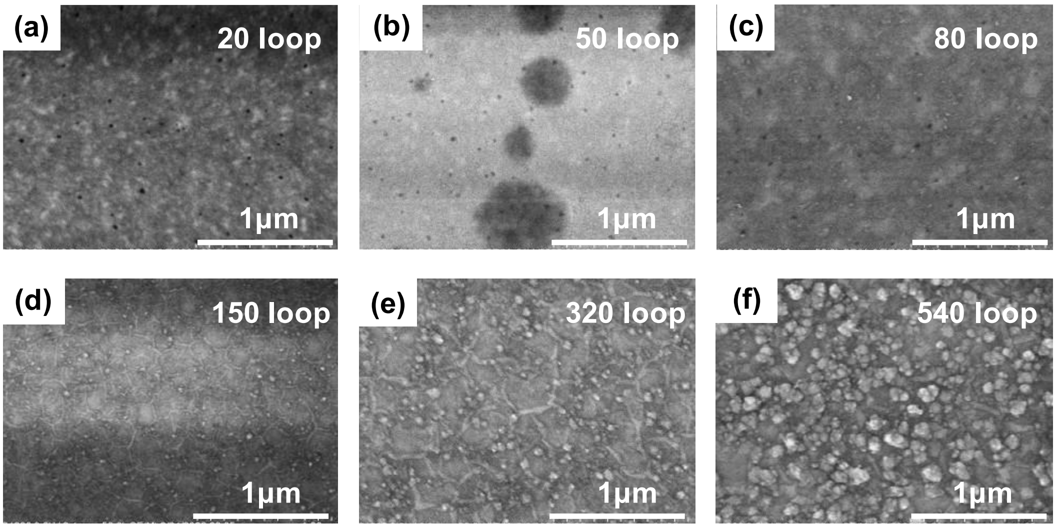

Figure S3 The surface morphology variations of h-BN films grown by NH_3/TEB/Itrp with the growth loops.

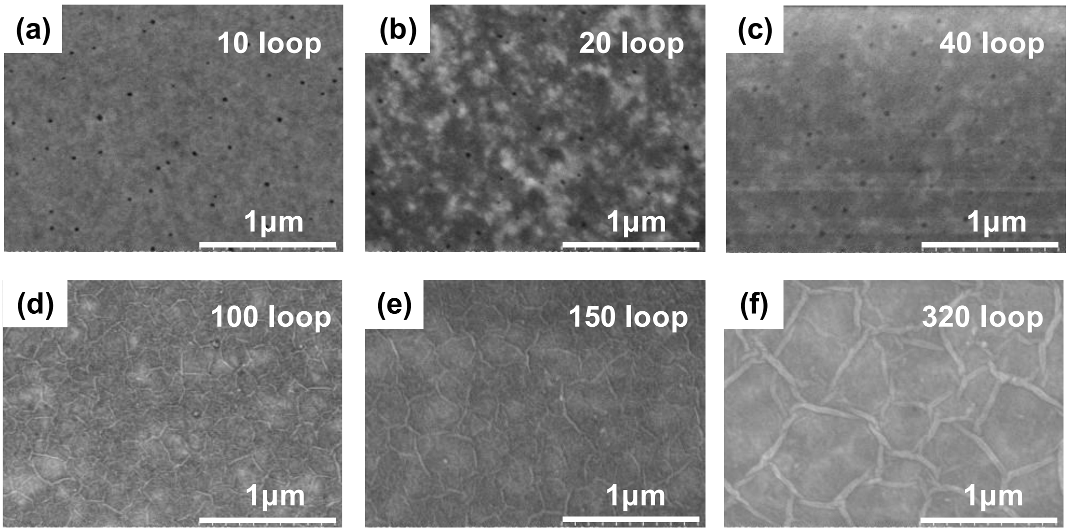

Figure S4 The surface morphology variations of h-BN films grown by NH_3/Itrp /TEB/Itrp with the growth loops.

The HR XP spectra pertaining to Al for the four samples can be seen in figures 6(a)–(d). For the samples using the modes of NH_3/TEB and NH_3/Itrp/TEB, the peak comprises of two main peaks pertaining to Al-O and Al-N bonds: the Al-O bonds derived from the sapphire substrate signal and the Al-N bonds contributed by the nitrided sapphire. It implies that the BN films grown under NH_3/TEB and NH_3/Itrp/TEB modes are very thin. There was no substrate dependent Al signal detected due to the thick BN film by NH_3/TEB/Itrp and NH_3/Itrp/TEB/Itrp modes.

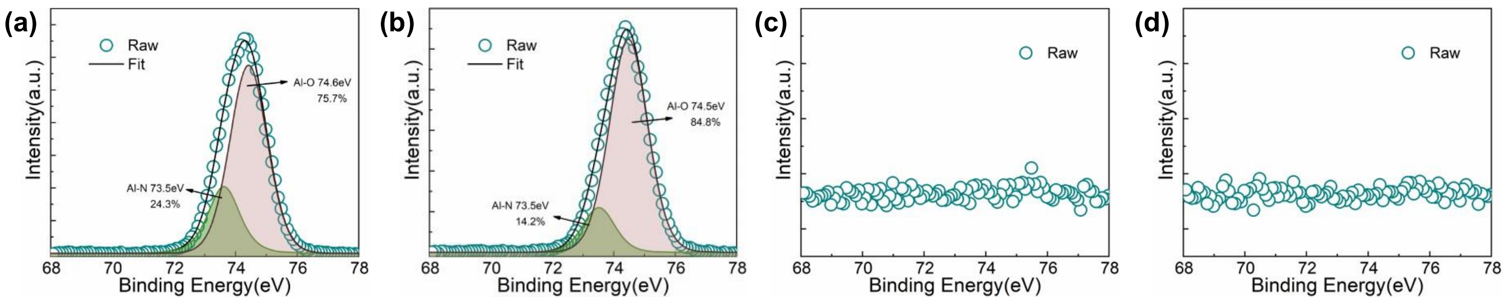

Figure S5 The XPS spectra of Al 2*p* peak in h-BN film under four FME modes [41]. (a) NH_3/TEB, (b) NH_3/Itrp/TEB, (c) NH_3/TEB/Itrp, (d) NH_3/Itrp/TEB/Itrp.

As shown in Figure S7, the highly symmetric O 1s core-level spectra is observed for all samples. For the NH_3/TEB and NH_3/Itrp/TEB modes, the peak is the signal for O-Al bonds. This corresponds to the Al-O bonds in Al 2p. For the NH_3/TEB/Itrp and NH_3/Itrp/TEB/Itrp modes, the peak is assigned to O-B bonds. This corresponds to the B-O bonds in B 1s. It comes from the incorporation of O impurities due to the fast growth rate.

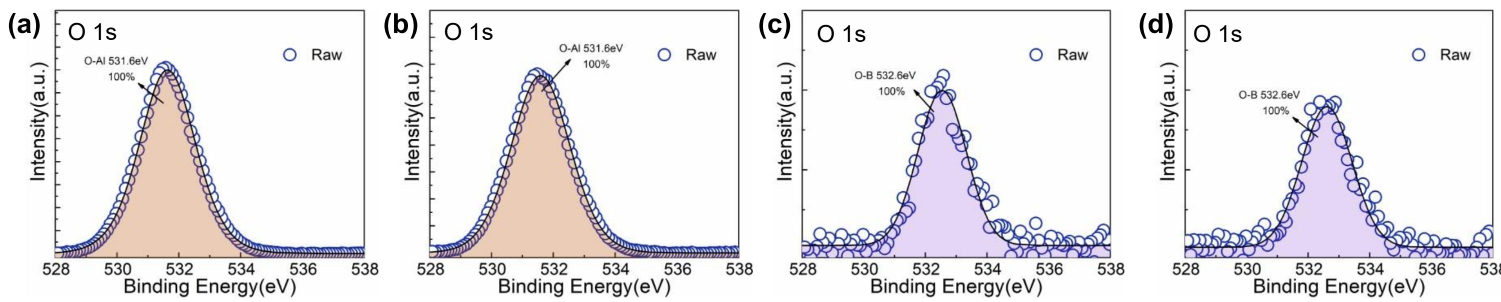

Figure S6 The XPS spectra of O 1*s* peak in h-BN film under four FME modes [41,46]. (a) NH_3/TEB, (b) NH_3/Itrp/TEB, (c) NH_3/TEB/Itrp, (d) NH_3/Itrp/TEB/Itrp.

Table S1. The variations of binding energy, FWHM and percentage content of different bonds of B 1s, N 1s and C 1s XPS core level spectra in h-BN films by four FME modes.

	B-N			**B-O**			**B-C**		
150loop	Position(eV)	FWHM(eV)	B-N%	Position(eV)	FWHM(eV)	B-O%	Position(eV)	FWHM(eV)	B-C%
NH_3/TEB	190.64	1.15	100	/	/	0	/	/	0
NH_3/Itrp/TEB	190.68	1.17	100	/	/	0	/	/	0
NH_3/TEB/Itrp	190.43	0.97	76.0	191.10	0.97	20.6	189.39	0.87	3.4
NH_3/Itrp/TEB/Itrp	190.50	1.04	75.2	191.29	1.00	12.1	189.69	1.09	12.7

	N-B			**N-Al**			**N-O**		
150loop	Position(eV)	FWHM(eV)	N-B%	Position(eV)	FWHM(eV)	N-Al%	Position(eV)	FWHM(eV)	N-O%
NH_3/TEB	398.32	1.20	65.1	397.17	1.24	34.9	/	/	0
NH_3/Itrp/TEB	398.25	1.24	81.7	369.98	1.19	14.9	400.11	1.43	3.4
NH_3/TEB/Itrp	398.20	1.19	100	/	/	0	/	/	0
NH_3/Itrp/TEB/Itrp	398.16	1.19	100	/	/	0	/	/	0

	C-C			**C-B**			**C-N**		
150loop	Position(eV)	FWHM(eV)	C-C%	Position(eV)	FWHM(eV)	C-B%	Position(eV)	FWHM(eV)	C-N%
NH_3/TEB	284.8	1.20	81.1	/	/	0	286.17	1.52	9.5
NH_3/Itrp/TEB	284.8	1.18	82.1	/	/	0	286.00	1.86	9.4
NH_3/TEB/Itrp	284.8	1.18	84.5	282.57	1.45	5.8	286.31	1.94	9.7
NH_3/Itrp/TEB/Itrp	284.8	1.28	79.2	282.47	1.28	12.7	286.58	1.30	8.2