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## Supporting Information for

# Tungsten carbide layers deposited on graphite substrates via

### wet powder process as anti-parasitic-reaction coating for

### reactor components in GaN growth

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#### **Table of Contents**

Table S1 Comparison of crystal quality of HVPE GaN layers grown with s	eed holders
made of d-WC/graphite and pBN/graphite	S2
Fig. S1 Comparison of AFM images of HVPE GaN surfaces	S3
Table S2 Impurity concentration in HVPE GaN layers measured by SIMS	S4
Fig. S2 SIMS mass spectra for HVPE GaN layers	S5

Table S1 Comparison of crystal quality of HVPE GaN layers grown with seed holders made of d-WC/graphite and pBN/graphite. Dislocation densities were estimated from the FWHM values of X-ray rocking curves. The surface roughness of the HVPE GaN layers is quite large due to the existence of etch pits. The etch pit density from AFM observation well corresponds to the sum of dislocation densities of screw- and edge-component dislocations.

	FWHM of X-ray rocking curve		Dislocation density <sup>*</sup> (cm <sup><math>-2</math></sup> )		AFM result	
	(002)	(102)	Screw <sup>*</sup>	Edge <sup>*</sup>	Root-mean-square roughness (nm)	Pit density $(cm^{-2})$
GaN grown w/ seed holder made of d-WC/graphite	443	410	$3.9  imes 10^8$	$8.4  imes 10^8$	4.1	$1.6 \times 10^9$
GaN grown w/ seed holder made of pBN/graphite	468	418	$4.4 \times 10^8$	$8.4  imes 10^8$	6.9	$2.1 \times 10^{9}$

\*Dislocation densities were calculated using equations in Ref. 64.



Fig. S1 AFM images of as-grown HVPE GaN surfaces grown with (a) d-WC/graphite and (b) pBN/graphite seed holders. (c, d) Magnified AFM images of (a, b), respectively. Dark spots (pits) can be attributed to etch pits (corresponding to threading dislocations), which likely formed during the cooling procedure after HVPE GaN growth runs.

Table S2 Impurity concentration measured by SIMS for HVPE GaN layers grown with seed holders made of d-WC/graphite and pBN/graphite. All detected concentrations were less than the background levels of the SIMS equipment.

	Impurity concentration measured by $SIMS^*$ (cm <sup>-3</sup> )					
	Hydrogen	Carbon	Oxygen	Silicon		
GaN grown w/ seed holder made of d-WC/graphite	$<$ 4 $\times$ 10 <sup>16</sup>	$< 1 \times 10^{16}$	$< 4 \times 10^{15}$	$< 2 \times 10^{15}$		
GaN grown w/ seed holder made of pBN/graphite	$< 4 \times 10^{16}$	$< 1 \times 10^{16}$	$< 4 \times 10^{15}$	$< 2 \times 10^{15}$		

\* Primary ion: Cs<sup>+</sup> at 15 keV; Secondary ion: negative.



Fig. S2 SIMS mass spectra for HVPE GaN layers grown with (a) d-WC/graphite and (b) pBN-graphite seed holders. No contamination of heavy metals was detected for either HVPE GaN layer. Although weak peaks corresponding to magnesium ( $\sim 10^{16}$  cm<sup>-3</sup>) were detected for both types of GaN layer, there was no difference in intensity; therefore, the origin of these peaks is considered to be not the seed holders, but other components of the HVPE reactor.