

Supplementary information

Table S1. *hkl* values for major phases in SR-XRD spectra as shown in Figures S1-S4.

CrN (A)	$\sim 2\theta$	Cr ₂ N (B)	$\sim 2\theta$	Cr (C)	$\sim 2\theta$	AlN (D)	$\sim 2\theta$
(111)	19.7	(110)	19.5	(111)	22.6	(111)	20.2
(002)	22.8	(111)	22.2	(002)	26.2	(002)	23.3
(022)	32.5	(112)	28.9	(022)	37.3	(022)	33.2
(311)	38.3	(013)	33.8	(311)	44.1	(311)	39.1
(222)	40.1	(031)	35.8	(222)	46.2	(222)	41
(004)	46.7	(113)	37.6	(004)	53.8	(004)	47.7
(331)	51.1			(331)	59.1		
(042)	52.5			(042)	60.8		
(422)	58.0			(422)	67.4		
(333)	61.9						
(044)	68.1						

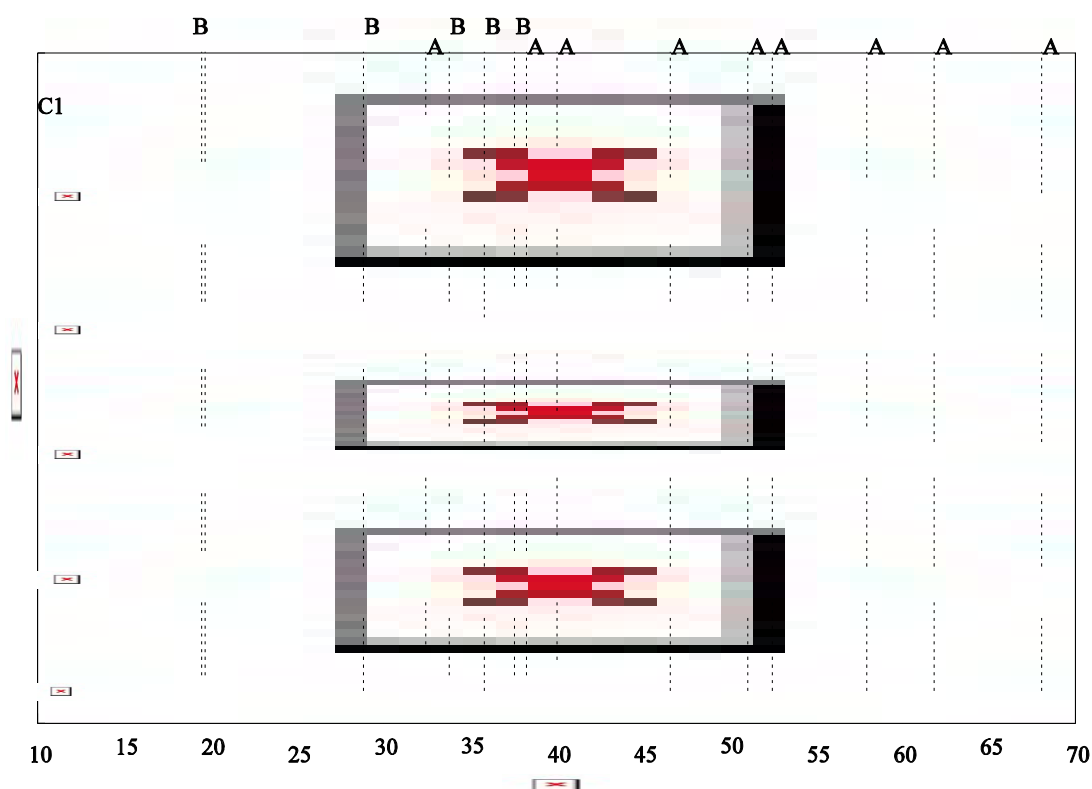


Figure S1. In-situ SR-XRD data for C1 coating heated from 25 to 700 °C in air

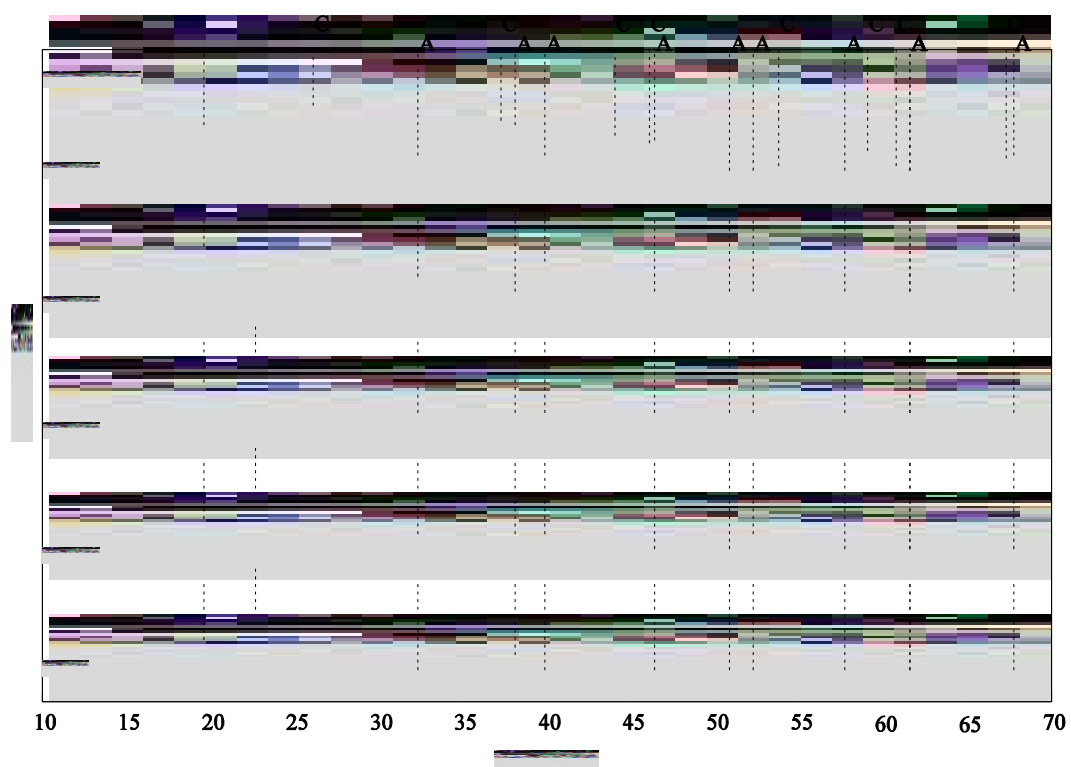


Figure S2. In-situ SR-XRD data for C2-14%Al coating heated from 25 to 700 °C in air

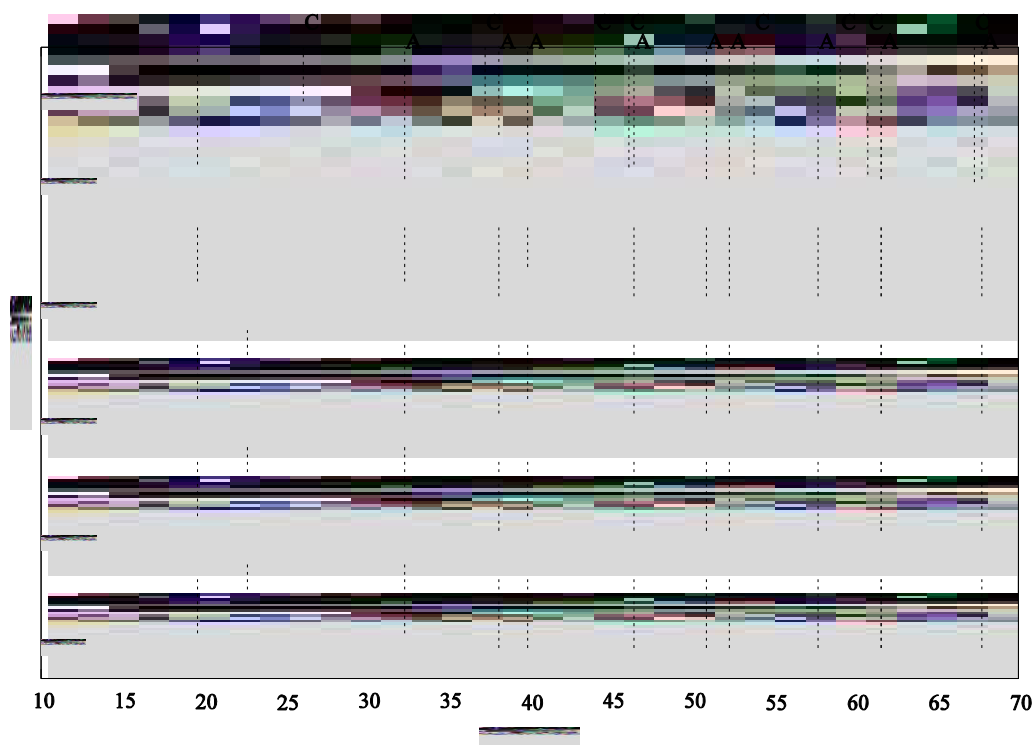


Figure S3. In-situ SR-XRD data for C3-17%Al coating heated from 25 to 700 °C in air

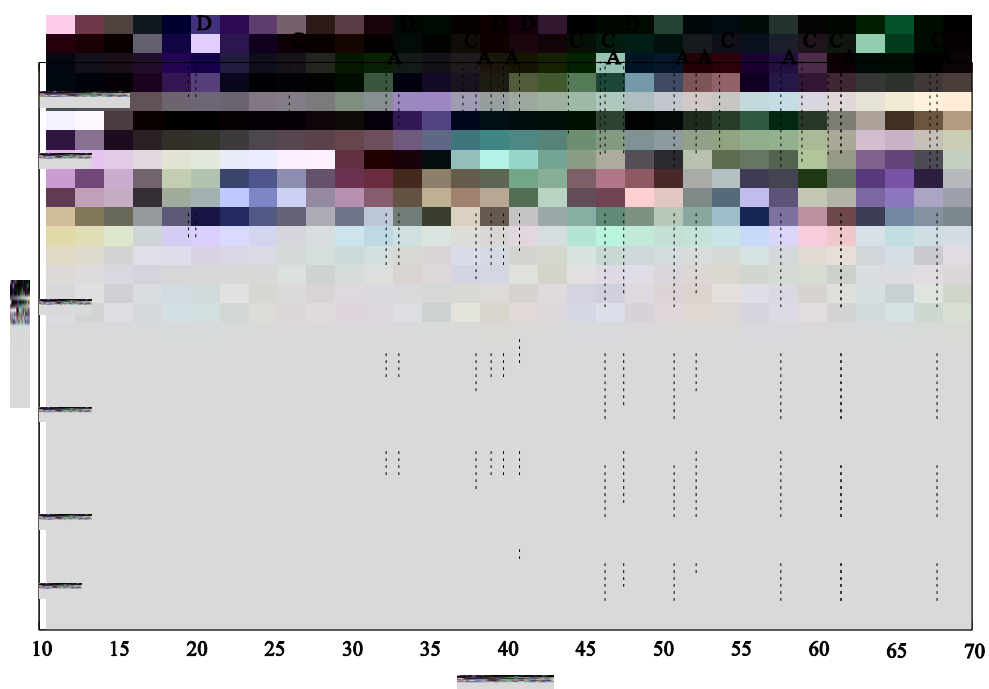


Figure S4. In-situ SR-XRD data for C4-21%Al coating heated from 25 to 700 °C in air

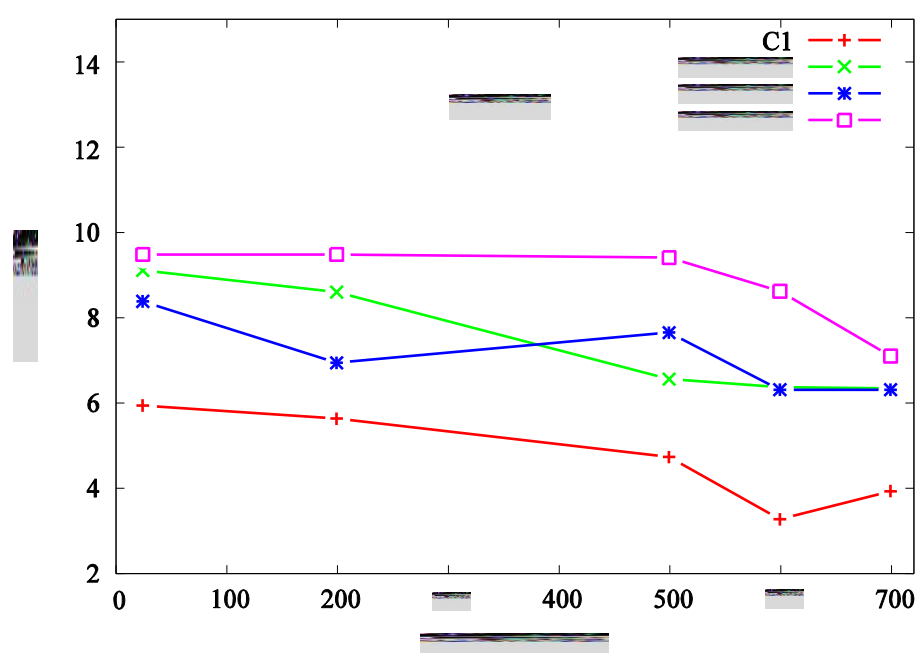


Figure S5. Stress in CrN structure for (111) orientations as function of temperature

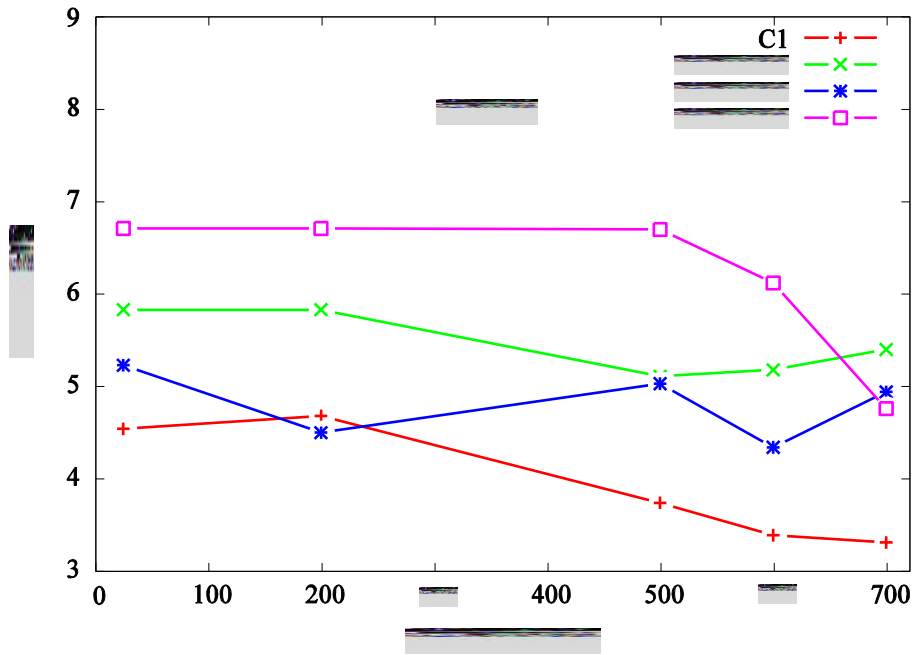


Figure S6. Stress in CrN structure for (200) orientations as function of temperature

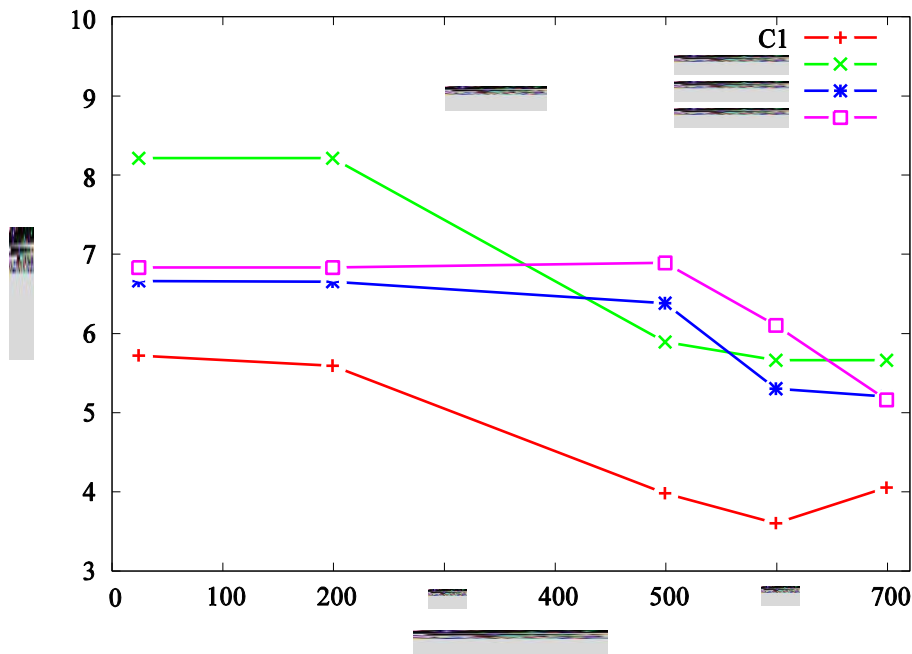


Figure S7. Stress in CrN structure for (311) orientations as function of temperature.

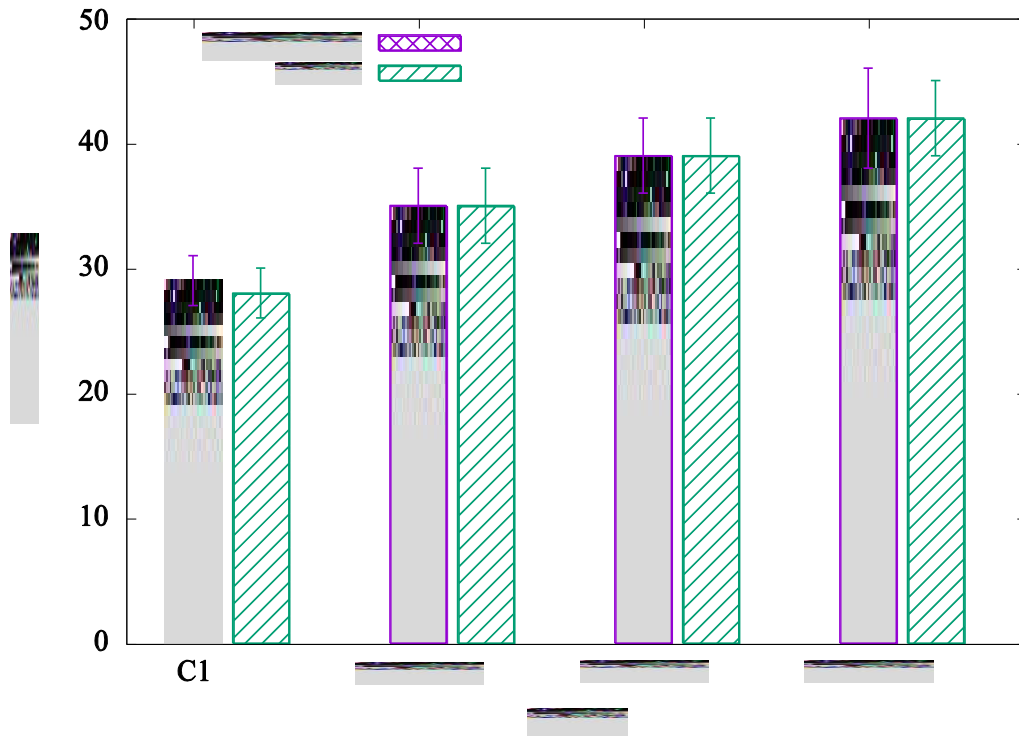


Figure S8. The Hardness (H) measured at room temperature for as-deposited and heated samples.

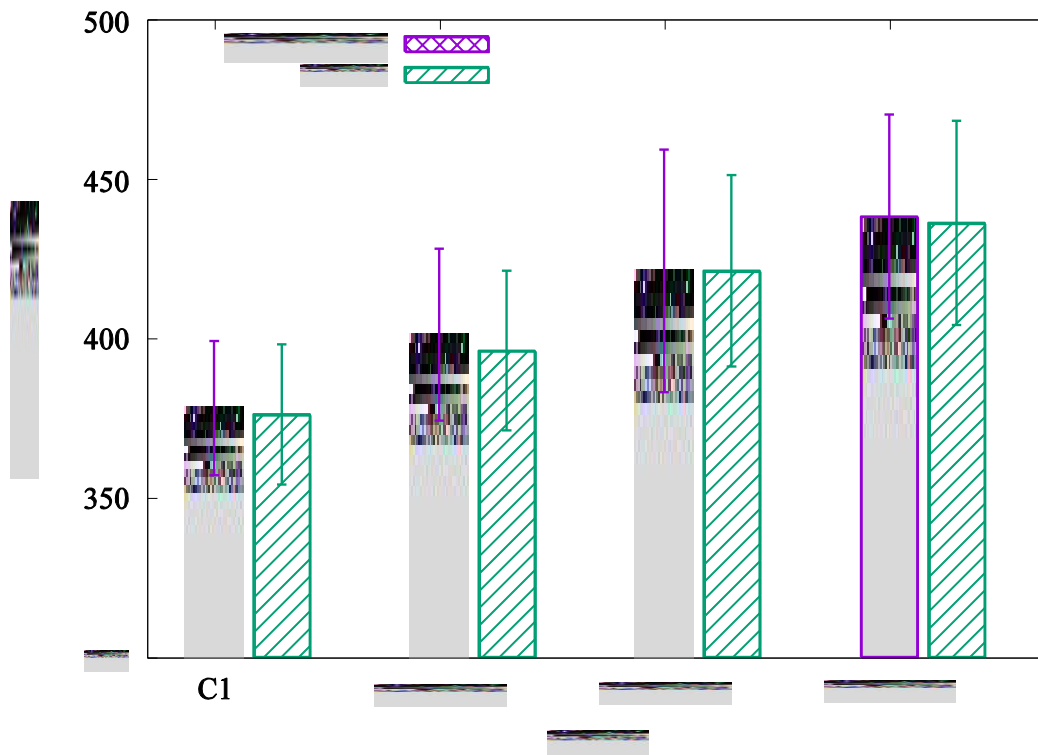


Figure S9. The Elastic modulus (E) measured at room temperature for as-deposited and heated samples.

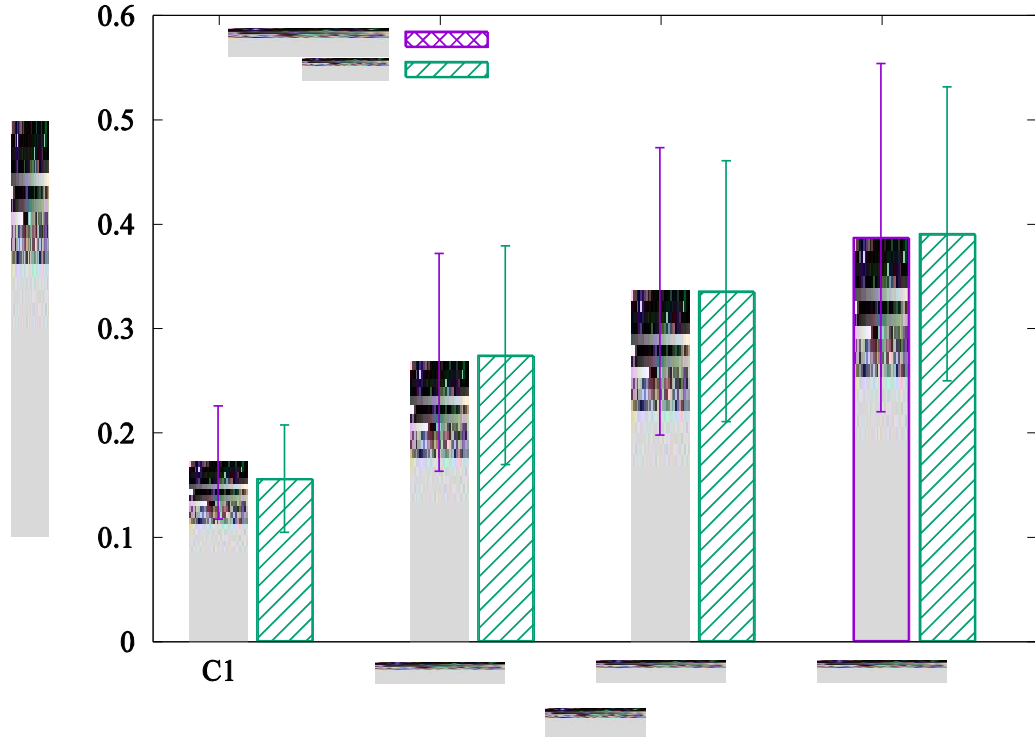


Figure S10. The resistance to deformation (H^3/E^2) measured at room temperature for as-deposited and heated samples.

Table S2. k-points grids, used in the VASP simulation, for elastic constants of CrN-m.

	Elastic constants		
k-points	C_{11}	C_{12}	C_{44}
$3 \times 3 \times 3$	514	201	118
$9 \times 9 \times 9$	311	38	60.3
13×13	395	126	60.3
15×15	377	110	62.0
21×21	376	115	61.7

Table S3. k-points grids, used in the VASP simulation, for elastic constants of CrN-nm.

	Elastic constants		
k-points	C_{11}	C_{12}	C_{44}
$5 \times 5 \times 5$	598	210	23.8
$9 \times 9 \times 9$	519	249	3.7
$13 \times 13 \times$	582	217	4.3
15×15	582	218	5.7
21×21	590	215	6.7
25×25	589	215.	6.1
$31 \times 31 \times$	588	215	5.9