Characterisation of a GaN {0001} Substrate using X-ray multiple diffraction in crystal by Renninger Scan

Tadashi Ohachi[1,2], Yuuki Sato[2], Kikurou Takemoto[1], Yoshiaki Hagi[3], Motoi Wada[2], Sinzo Yoshikado[2]

[1]Interfce Reaction Epitaxy Laboratory, [2]Faculty of Science and Engineering Doshisha Univ. [3]Sumiden Semiconductor Materials Co., Ltd.

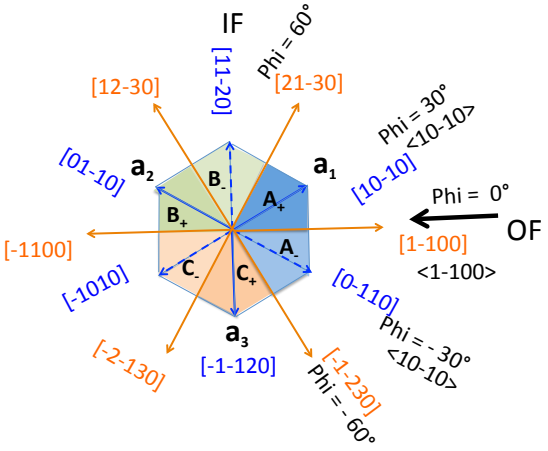
*E-mail: tohachi@irel.jp

Fixed chi phi (FCP) 360 deg scanning with small divergent incident parallel beam X-ray multiple diffraction (XRMD) in forbidden reflections 0001 is presented for characterisation of a GaN{0001} substrate. XRMD patterns are related to the wave length of a used X-ray of Cu $K_{\alpha 1}$, λ=0.154 nm. There are 14 peaks within a 30 deg basic crystalline symmetric region in FCP scan. Crystalline quality of the substrate is calculated from ratios of the peak 7 and 8 intensities and a back ground intensity between the peak 7 and 8, or 0002 Bragg reflection intensities at the same phi angles of the peak 7 and 8. The intensity of the peak 8 is the highest one for Cu $K_{\alpha 1}$, which related XRMD with (1-100) and (-1101) planes and the intensity of the XRMD peak 7 is formed from reflection with (02-11) and (02-20) planes in the 0001 forbidden reflection.

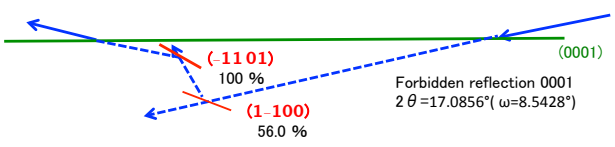
[1] J. Bl¨asing and A. Krost, Phys. Status SolidiA201**, R17 (2004).**

[2] M. Renninger, Z. Phys. 106**, 141–176 (1937).**

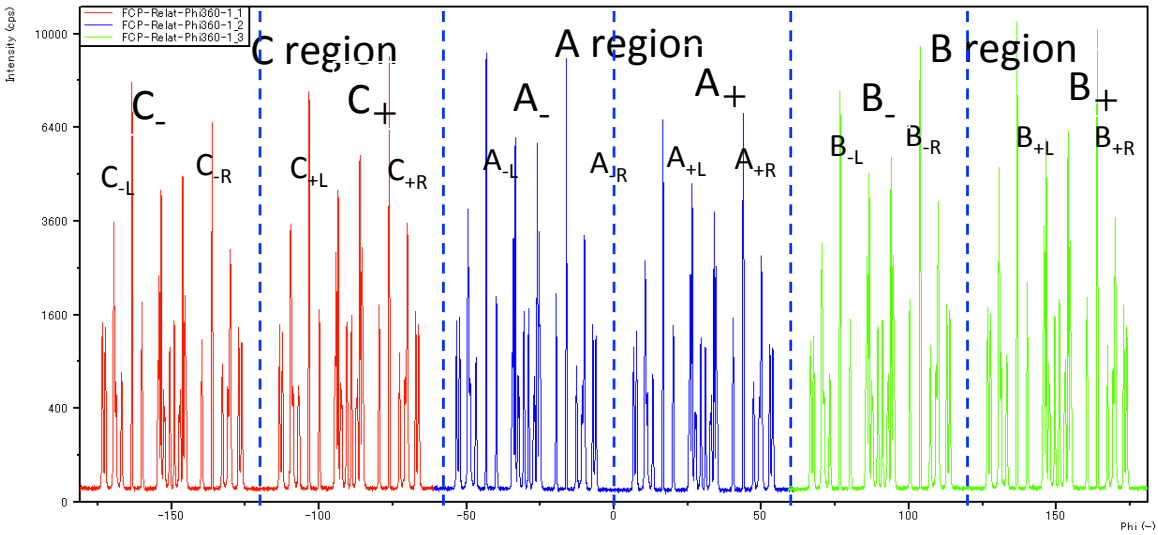
[3] S.-L. Chang, X-Ray Multiple-Wave Diffraction: Theory and Application (Springer, Berlin, 2004).



Six fold symmetry of hexagonal GaN {0001}

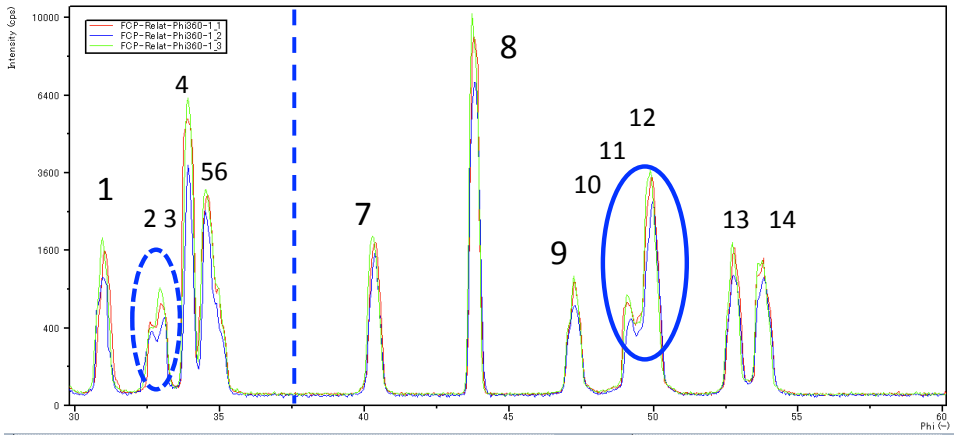


X-ray multiple diffraction (XRMD)



A $_{+R}$region
30°～60°

30°
Basic peaks



	Peak No.	Indexed Peaks by Blasnig & Krost	Phi [degree]	Relative Intensity [%]	refrection type
mp1	1	P1	0.87	15.0	(3–1–10)/(–3211)
	2		2.47	11.5	
	3	P2	2.87	2.6	(3–1–2–2)/(–3123)
	4	P3	3.81	60.8	(1–10–1)/(–1101)
	5		4.45	34.4	
	6		4.73	13.3	
mp2	7	P5	10.15	24.1	(02–21)/(0–220)
	8	P6	13.65	100.0	(1–100)/(–1101)
	9		17.13	11.9	
	10	P7	18.99	12.1	(12–33)/(–1–23–2)
	11		19.3	15.5	
	12	P8	19.67	46.0	(01–13)/(0–11–2)
	13	P9	22.67	15.5	(3–1–20)/(–3121)
	14	P10	23.55	19.3	(02–23) /(0–2–-2)