

XRD Characterization of GaN(0002) on Si(111) films Grown by RF-MBE

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GaN on Si (GoS) films for high frequency and high power transistors, such as HEMT are currently interested. In this report characterization of AM-MEE (activity modulation migration enhanced epitaxy) grown GoS films on an AlN on Si (AoS) is shown by using XRD rocking curve and pole figure. The AoS template is grown by an interface reaction epitaxy on double buffer layer (DBL) of AlN/ β -Si₃N₄/Si and followed by AM-MEE of radio frequency molecular beam epitaxy (RF-MBE) method. In order to grow high quality GoS the effect of graded buffer layer of Al_{1-x}Ga_xN (x= 0 to 1) on DBL is examined. Thickness GaN and AlN films are desined by number of sequence of AM-MEE and measured by grazing incidence X-ray reflectivity (GIXR). V80H MBE chamber using 800L/s TMP with an IRFS-501 rf nitrogen radical source made by Arios Inc are used [1-4].

The three samples of GoS of 2 inch wafers as shown in Table 1 are characterized by XRD 2θ - ω scanning in Fig.1, pole figure for f145 sample in Fig.2 and FWHM of ω rocking curve in Fig. 3. Fig. 1 is normalized by AlN(0002) peaks and shows effect of graded buffer of Al_{1-x}Ga_xN (x= 0 to 1) grown on DBL for g033 sample. Ratio of peak height between GaN(0002) and AlN(0002) corresponds thickness of GaN films. Fig.2 shows a single domain GaN(0002) film was grown on Si(111) film observed by GaN(11-4) pole figure for f145 sample. FWHM of f145 are listed in Fig.3. FWHM of GaN(0002) and AlN(002) for g033 are 0.52 and 0.596 deg, respectively. FWHM of GaN(0002) for g404 is 0.777 deg.

Table 1 Sample structure

	f145	g033	g404
GaN [nm]	191	90	43
AlGaIn [nm]		36	
AlN [nm]	36		40

Thicker films of GaN gives small FWHM. AM-MEE of RF-MBE following IRE growth of DBR on Si is promising to grow high quality GaN films without to grow thicker buffer film like MOCVD growth. Another merit of this system is preparing electronic devices from Si substrate in one process in a MBE chamber.

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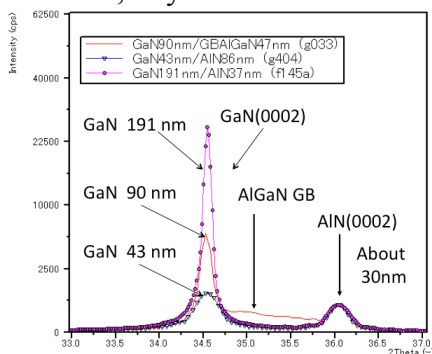


Fig. 1 2θ - ω XRD graph for g033, g404, f145

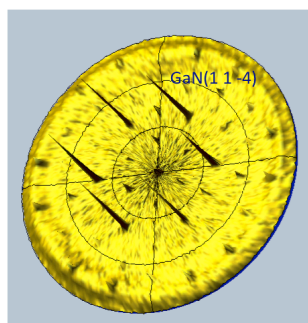


Fig.2 Pole figure of (11-4) for GaS film of f145 sample

	(h k l)	Counts	FWHM [deg]
GaN	1 0 0	5779	0.67
	2 0 0	2569	0.686
	3 0 0	11337	0.72
	0 0 2	355847	0.325
	0 0 4	556285	0.336
	0 0 6	256309	0.37
AlN	1 0 0	2030	0.748
	2 0 0	107	0.925
	3 0 0	249	0.667
	0 0 2	198621	0.447
	0 0 4	13902	0.464
	0 0 6	8010	0.781

Fig.3 FWHM for f145 sample