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GaAs Etching using Unaxis ICP Etcher

Objective: To etch GaAs using Unaxis ICP etcher at a low-temperature with a laser interferometer monitoring the etch depth.

Experimental: GaAs samples, patterned with a SiO_2 etch mask (~490nm), were mounted onto a Si carrier (~1mm) using pump oil, and then, etched inside of Unaxis PM1 chamber. The etch depth, etch selectivity, and etch profile were obtained from SEM pictures. The wavelength of the laser used to monitor the etch depth is 674.8nm.

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Results:

1) Table 1

GaAs Etching using Unaxis PM1 Etcher (30C)														
Sample#	Bias		ICP (W)	Pressure (mT)	Throttle Valve Openness (%)	Gas Flow-Rate (sccm)		Etch Time (min.)	Chuck Temperature (^{o}C)	Average Etch Depth (nm)	Average SiO2 Thickness (nm)	Etch Rate (nm/min.)	Selectivity (GaAs/SiO2)	Average Side-wall Angle (^{o})
	Power (W)	Voltage (V)				CL2	N2							
GaAs#01	75	120	900	1.9*	65.747	20	10	3	30	2210	266	736.7	9.9	90.0
GaAs#02	75	119	900	1.9*	46.875	10	10	3	30	1530		510.0		90.0
GaAs#03	75	126	900	1.9*	64.38	10	20	3	30	883		294.3		90.0
GaAs#04	75	133	900	1.9*	62.524	5	25	3	30	470	317	156.7	2.7	82.1
GaAs#05	25	57	900	1.9*	63.696	5	25	5	30	483	345	96.6	3.3	82.7
GaAs#06	50	122	500	1.9*	66.431	10	20	3	30	933	337	311.0	6.1	90.0
GaAs#07	100	162	900	1.9*	63.306	5	25	5	30	810		162.0		80.2
GaAs#08	50	99	900	1.9*	64.478	5	25	5	30	735	274	147.0	3.4	83.5
GaAs#09	50	96	900	1.9*	65.747	10	20	3	30	861	366	287.0	6.9	90.0
GaAs#10	100	157	900	1.9*	64.282	10	20	3	30	1177	232	392.3	4.6	84.5
GaAs#11	75	125	900	1.8	49.219	5	15	4	30	811	273	202.8	3.7	83.0
GaAs#12	50	91	900	1.8	49.463	5	15	4	30	710		177.5		83.4
GaAs#13	50	93	900	1.8	49.487	4	16	5	30	645	278	129.0	3.0	82.2
GaAs#14	50	93	900	1.8	49.561	3.3	16.7	5	30	630	275	126.0	2.9	82.9
GaAs#15	50	89	900	1.5	54.712	3.3	16.7	5	30	529	342	105.8	3.6	83.0
GaAs#16	50	89	900	1.5	54.81	4	16	5	30	623	298	124.6	3.2	83.0
GaAs#17	50	90	900	1.5	54.565	2.5	17.5	7	30	641	256	91.6	2.7	82.6
GaAs#18	25	51	900	1.5	54.956	2.5	17.5	7	30	352	338	50.3	2.3	80.2

*: Chamber pressure was set at 1.5mT, but, there was -0.4mT zero-point drift in the throttle-valve controller.

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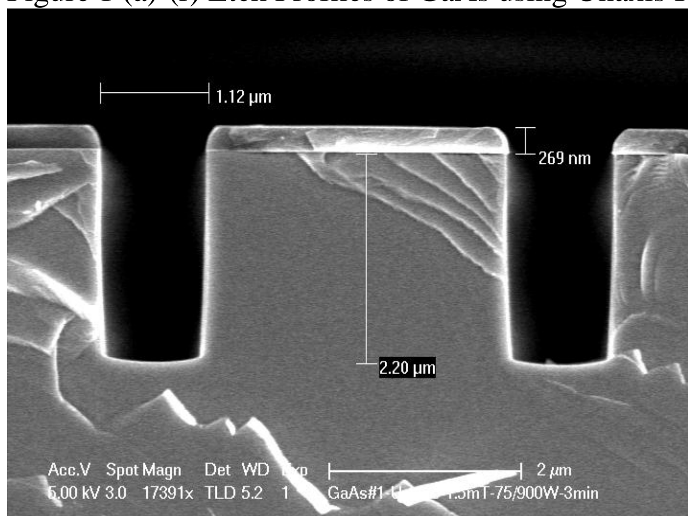
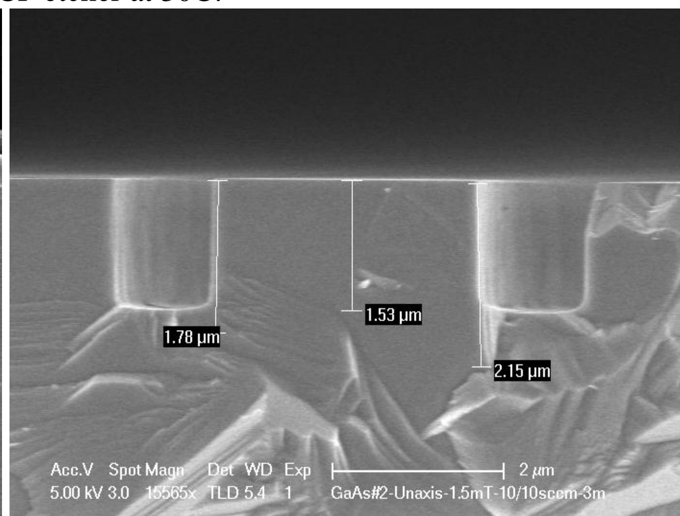
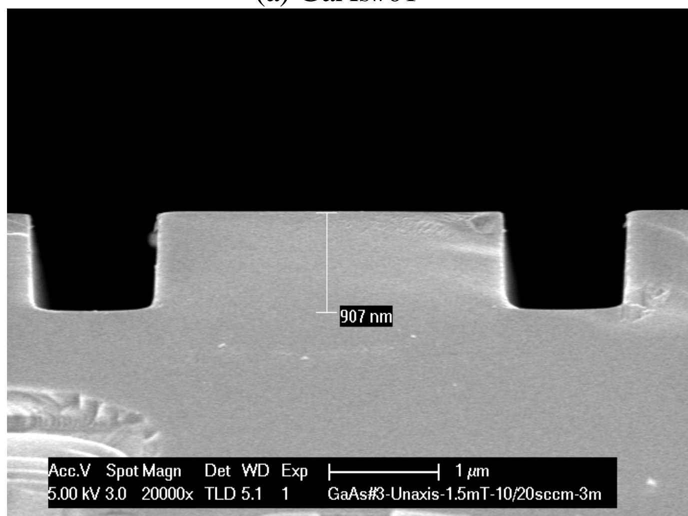
Figure 1 (a)-(r) Etch Profiles of GaAs using Unaxis ICP etcher at 30C.



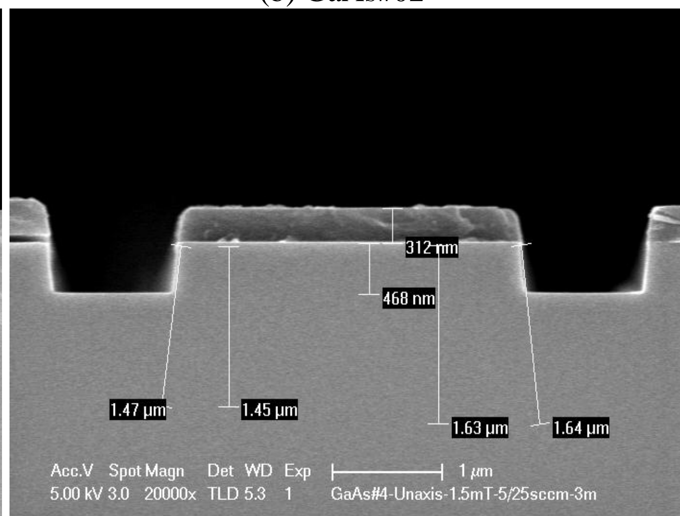
(a) GaAs#01



(b) GaAs#02



(c) GaAs#03



(d) GaAs#04

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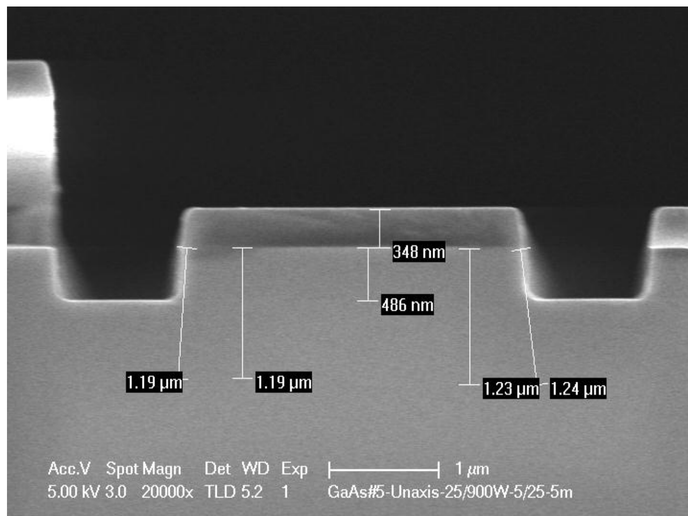
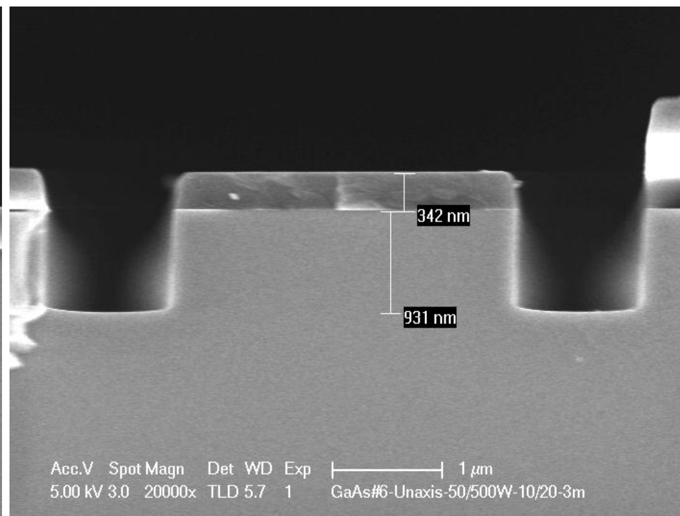
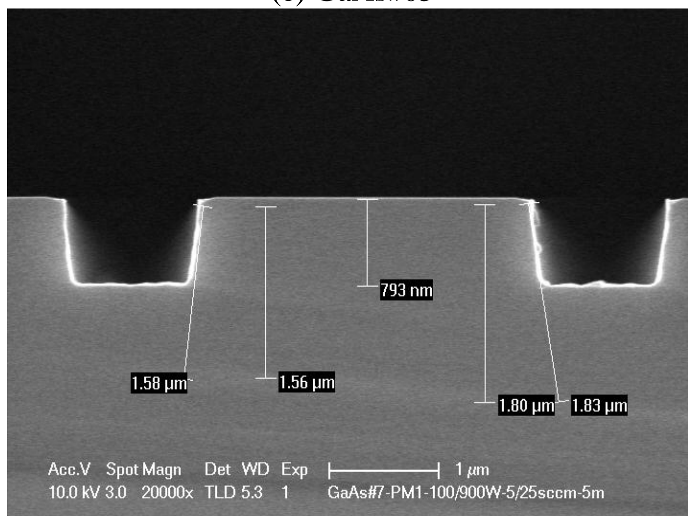


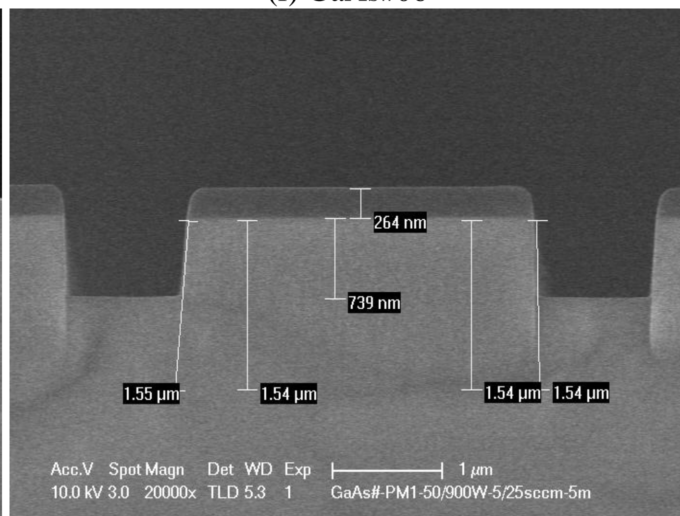
(e) GaAs#05



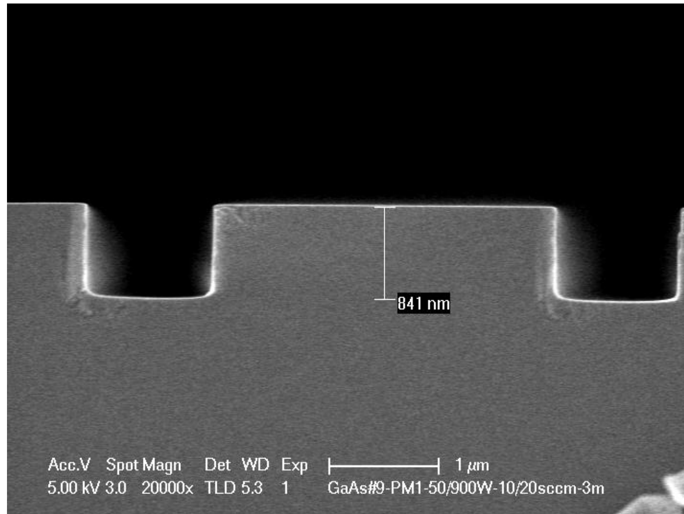
(f) GaAs#06



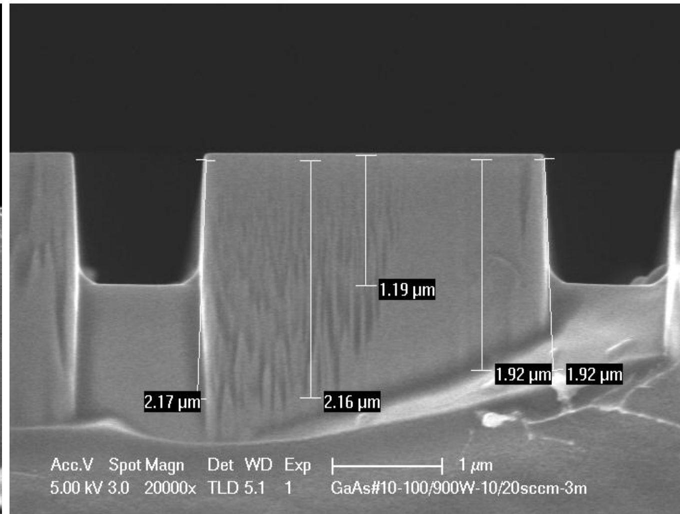
(g) GaAs#07



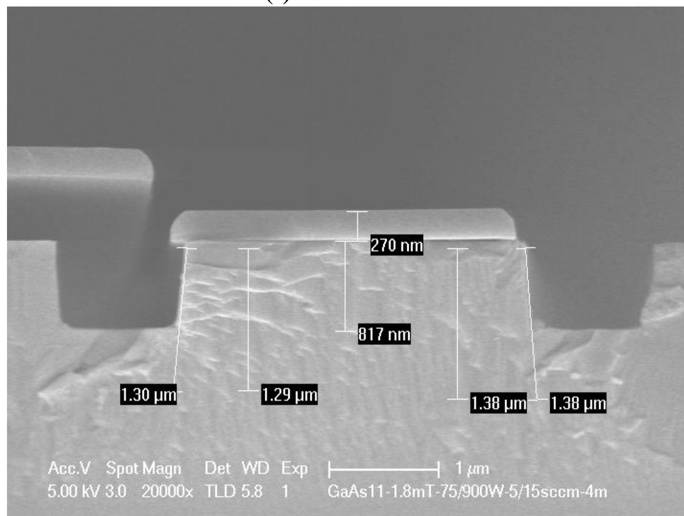
(h) GaAs#08



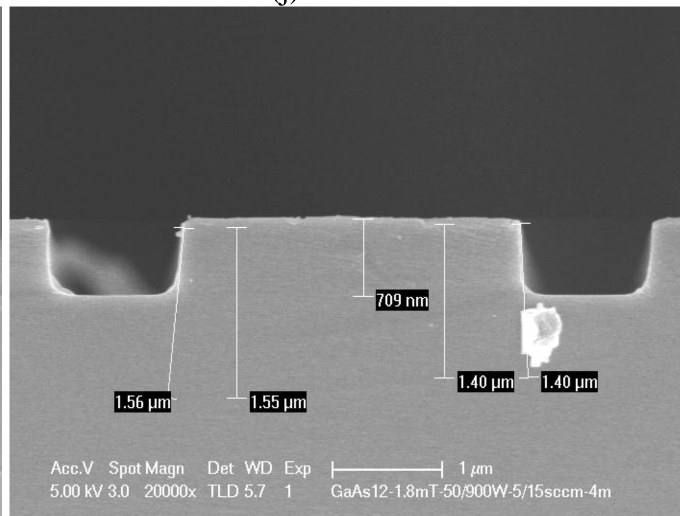
(i) GaAs#09



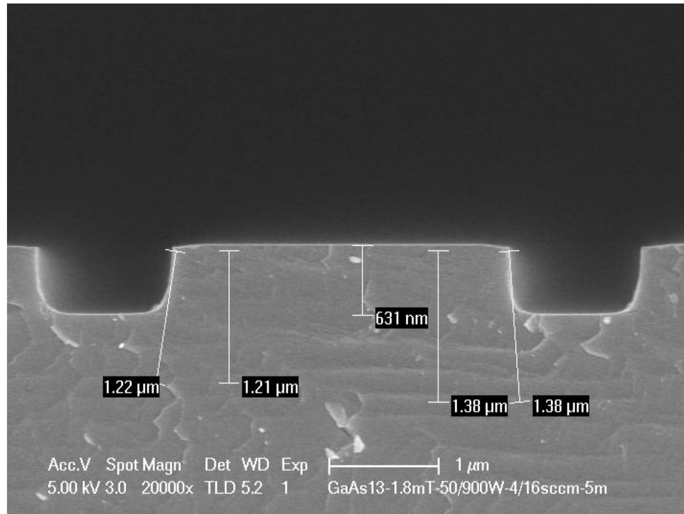
(j) GaAs#10



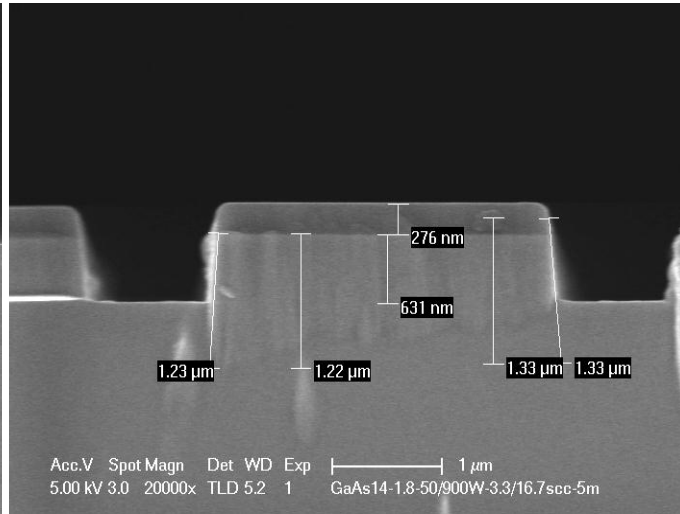
(k) GaAs#11



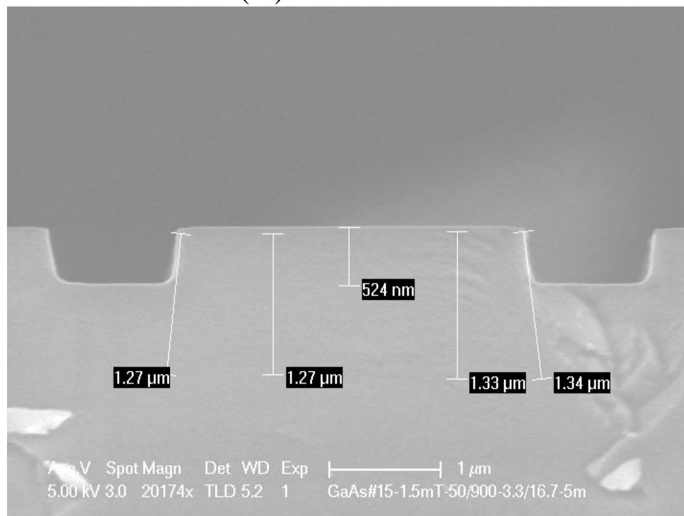
(l) GaAs#12



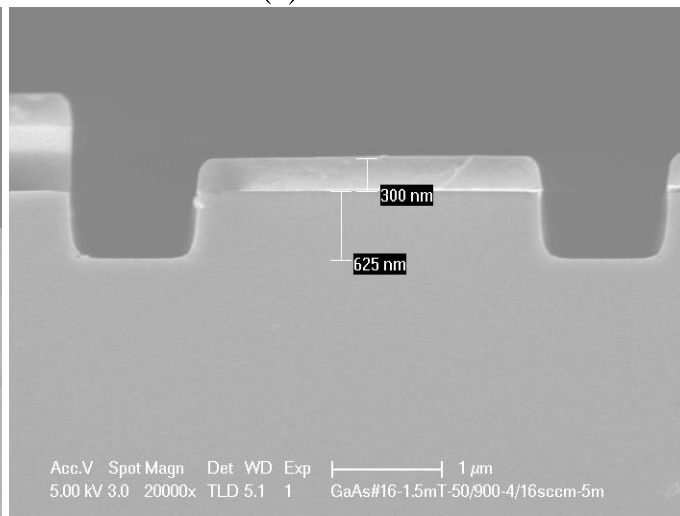
(m) GaAs#13



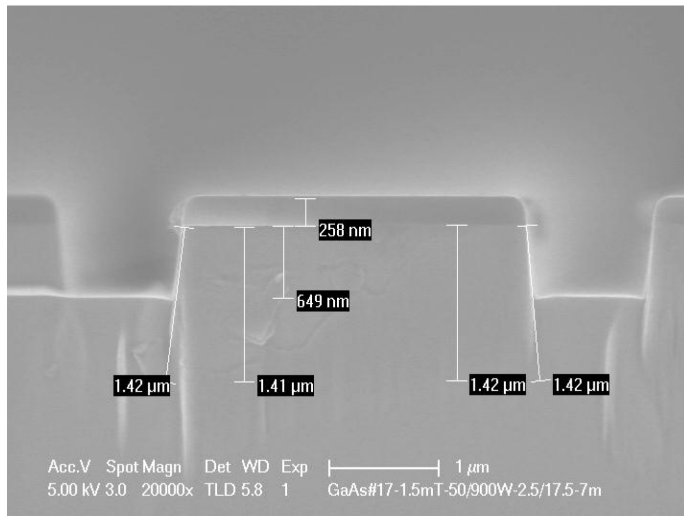
(n) GaAs#14



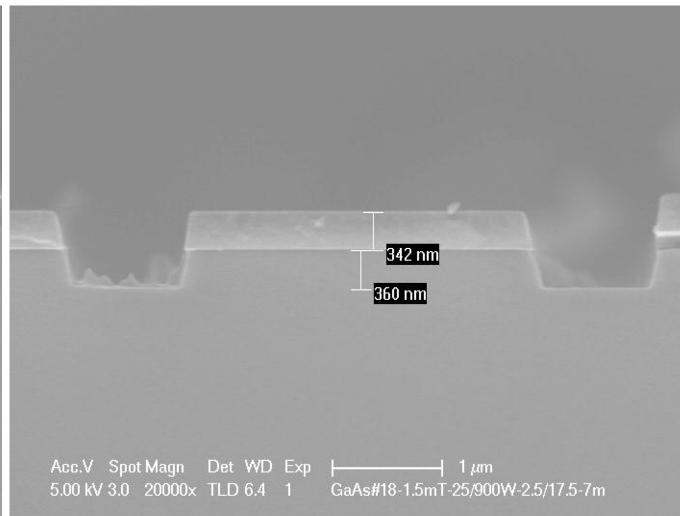
(o) GaAs#15



(p) GaAs#16



(q) GaAs#17



(r) GaAs#18

Figure 2

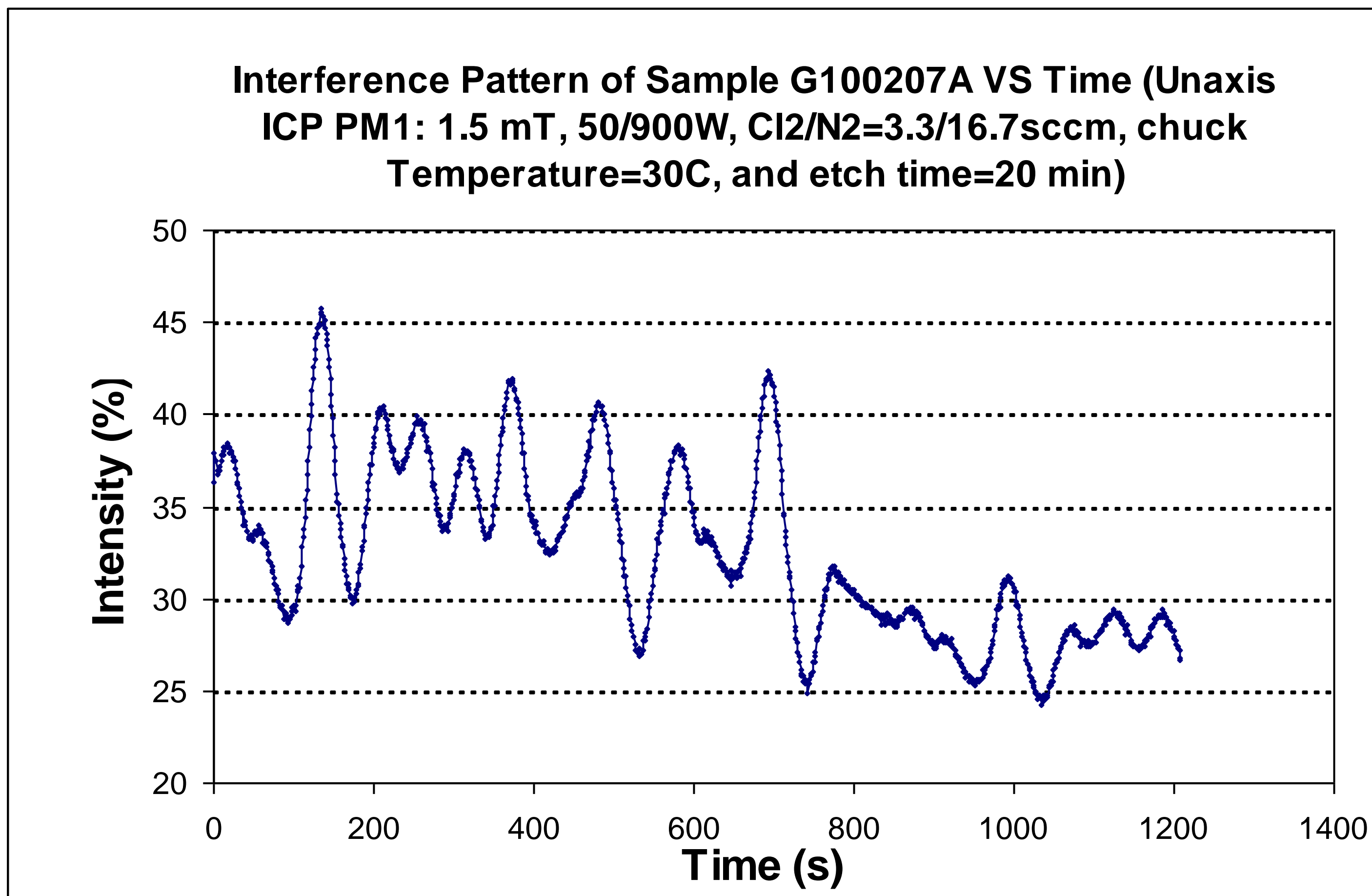


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Figure 3 Etch profile of sample G100207A. The etch condition was 1.5mT, 50/900W, Cl2/N2=3.3/16.7sccm, and time=20min. (as one can see, the sample was over-etched into GaAs substrate and the top mask and EPI layers were etched too).