

AlAs-GR-Cal Etching using Unaxis ICP Etcher

Experimental: Etching AlAs-GR-Cal samples (see EPI structure below), with the use of SiO₂ etch mask (~400nm), using Unaxis PM1 at 30 C.

The details are as follows,

- 1)Cleaning wafer: Acetone (3min in Ultrasonic bath) + Methanol (2min in ultrasonic bath); Dipping into NH₄OH:DI(1:20) for 20s (removing native oxide); DI water rinse and N₂ blow-dry.
- 2)Depositing SiO₂ at 100 C using Unaxis PM3 deposition tool with pressure=15mT, bias/ICP power=5/400W, SiH₄/O₂/He flow-rate=5.9/10/245sccm, and deposition time=967s.
- 3)Patterning the etch-mask using the old stepper with SPR-955-0.9 resist, exposure time=1.1s, and development time=60s (AZ726MIF).
- 4)Etching the SiO₂ mask using Panasonic#2 etcher with pressure=0.5Pa, bias/ICP power=50/900W, CF₄/CHF₃ flow-rate=20/20sccm, and etch time 235s.
- 5)Removing the remaining resist on the top of SiO₂ mask using PRX-127 stripper: 10min+10min at 80 C, then, acetone and methanol clean, DI water rinse and N₂ blow-dry; O₂ plasma descum at 300mT/100W for 1 min.
- 6)O₂ plasma PM1 chamber clean at 200 C for 30 min.**
- 7)Cl₂ plasma PM1 chamber coating at 30 C for 1 min.**
- 8)Mounting sample onto a Si carrier (~1mm) using pump oil.**
- 9)Etching sample inside PM1 chamber.
- 10)Coating samples' surface and taking SEM pictures.

Ning Cao, Staff Engineer, Nanofab Lab, UCSB

Table 1. AlAs GR Cal structure (GaAs =0.417 μ m, AlAs=0.7461 μ m, and total=1.1631 μ m).

AlAs GR cal	
GaAs	69.5nm
AlAs	82.9nm
GaAs	69.5nm
AlAs	82.9nm
GaAs	69.5nm
AlAs	331.6nm
GaAs	69.5nm
AlAs	82.9nm
GaAs	69.5nm
AlAs	82.9nm
GaAs	69.5nm
AlAs	82.9nm
2" semi-insulating GaAs	

Table 2. Etching results.

AlAs-GR-Cal sample etching using Unaxis PM1 at 30C										
sample#	Date	Pressure (mT)	Flowing Gas (sccm)		Bias		ICP Power (W)	Etch Time (min)	Etch Rate (μ m)	Etch Selectivity ([AlAs/GaAs]/SiO ₂)
			Cl ₂	N ₂	Power (W)	Voltage (v)				
AlAs#01	8/23/2010	2	20	0	75	117	900	2	1.68	15.6
AlAs#02	8/23/2010	2	20	0	75	186	300	5	1.62	N/A
AlAs#03	8/23/2010	2	20	10	75	134	900	3	0.88	13.8

Ning Cao, Staff Engineer, Nanofab Lab, UCSB

Figure 1. SiO₂-etch-mask profile of un-etched sample.

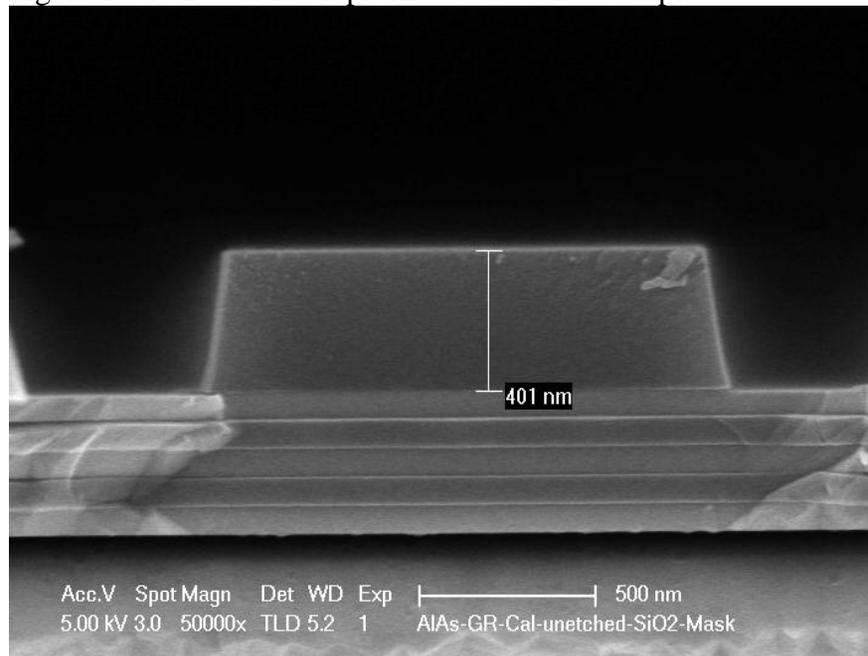


Figure 2. Etch profile of AlAs#01 (the AlAs layer was broken due to the oxidation in air).

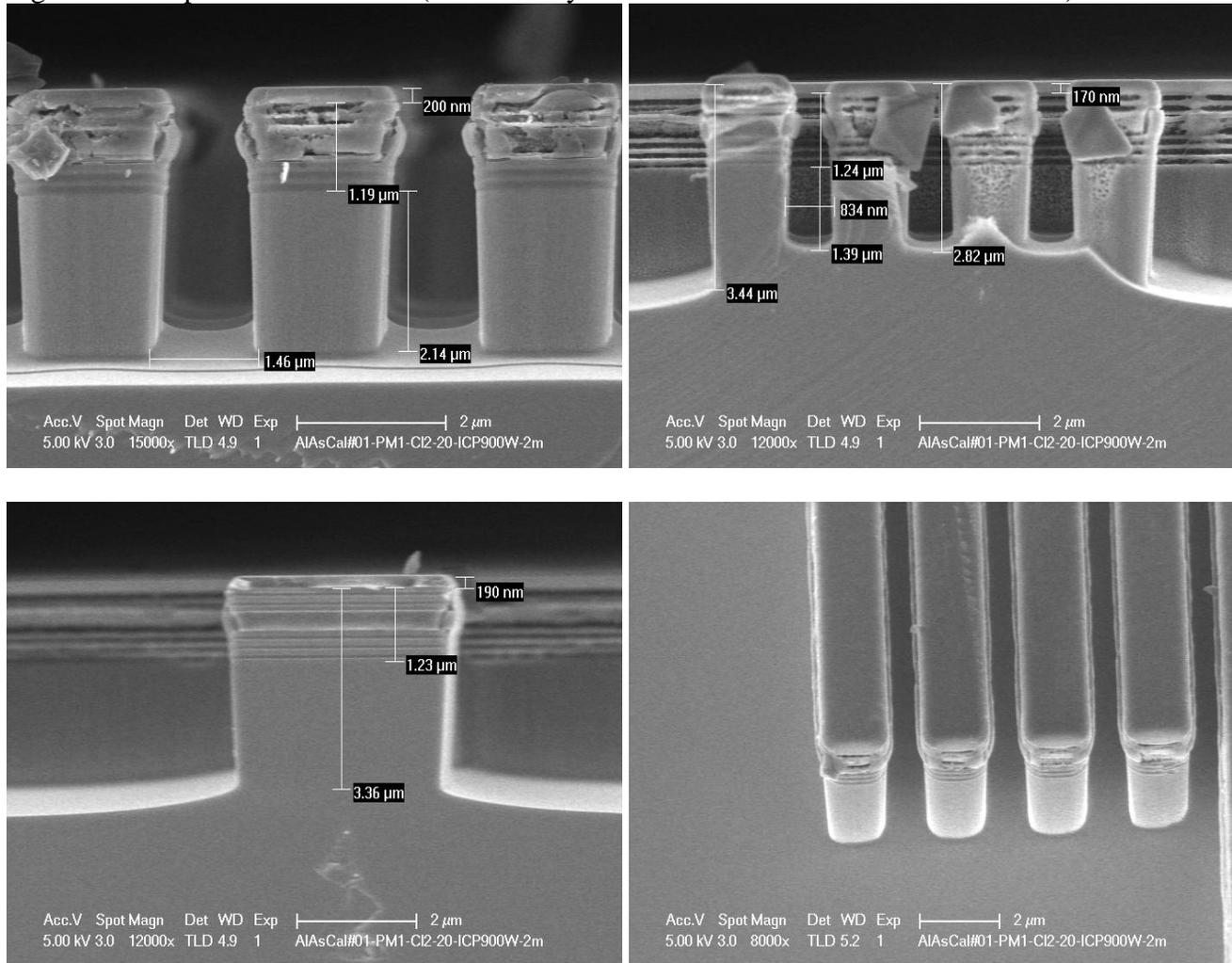


Figure 3. Etch profile of AlAs#02 (under-cut and roughness due to too much chemical etch).

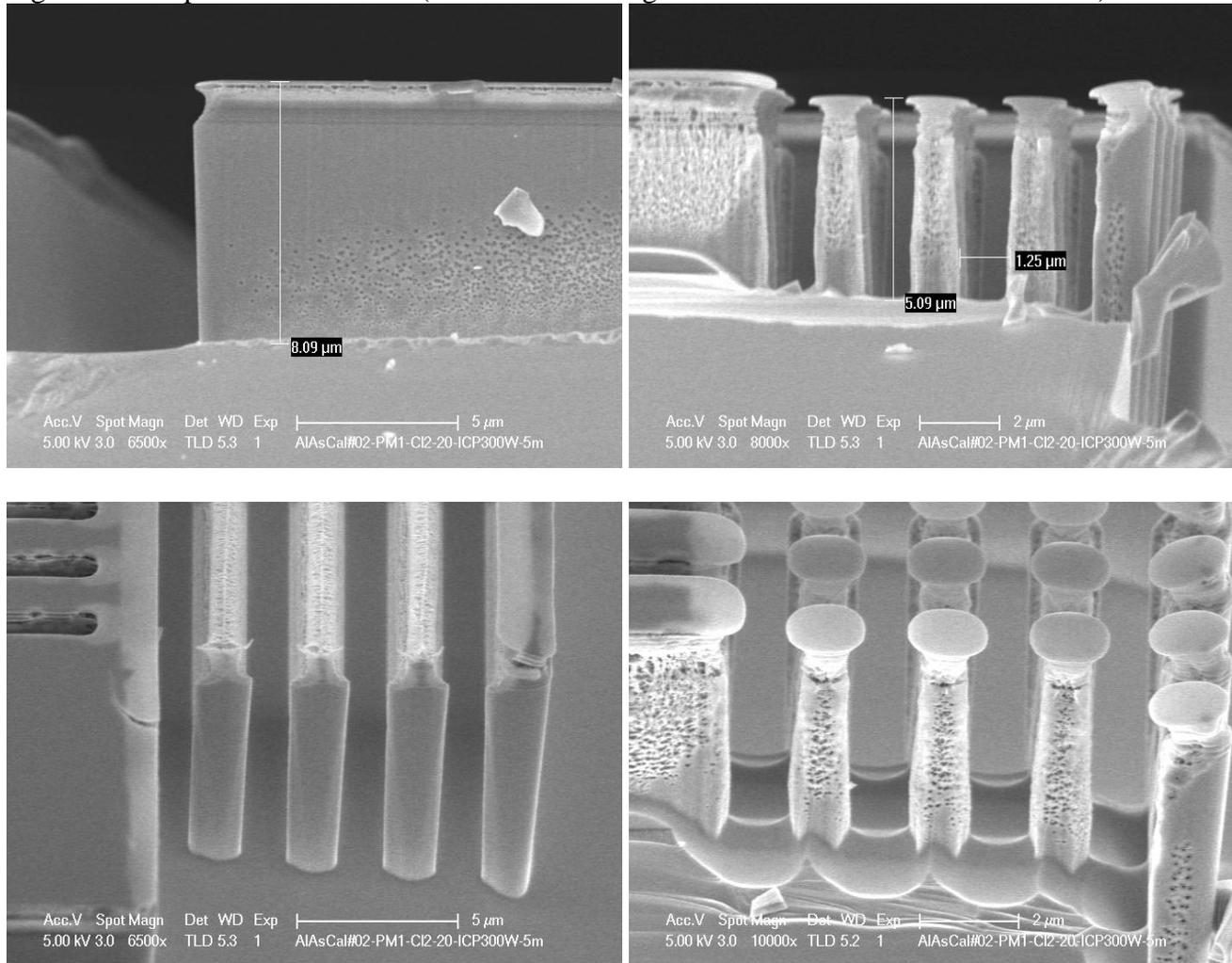


Figure 4. Etch profile of AlAs#03 (vertical side-wall and smooth etched surface; no grass appearing on surface).

