InP Grating Etches

Oxford PlasmaPro 100 Cobra 300

Ning Cao

2021-08-26

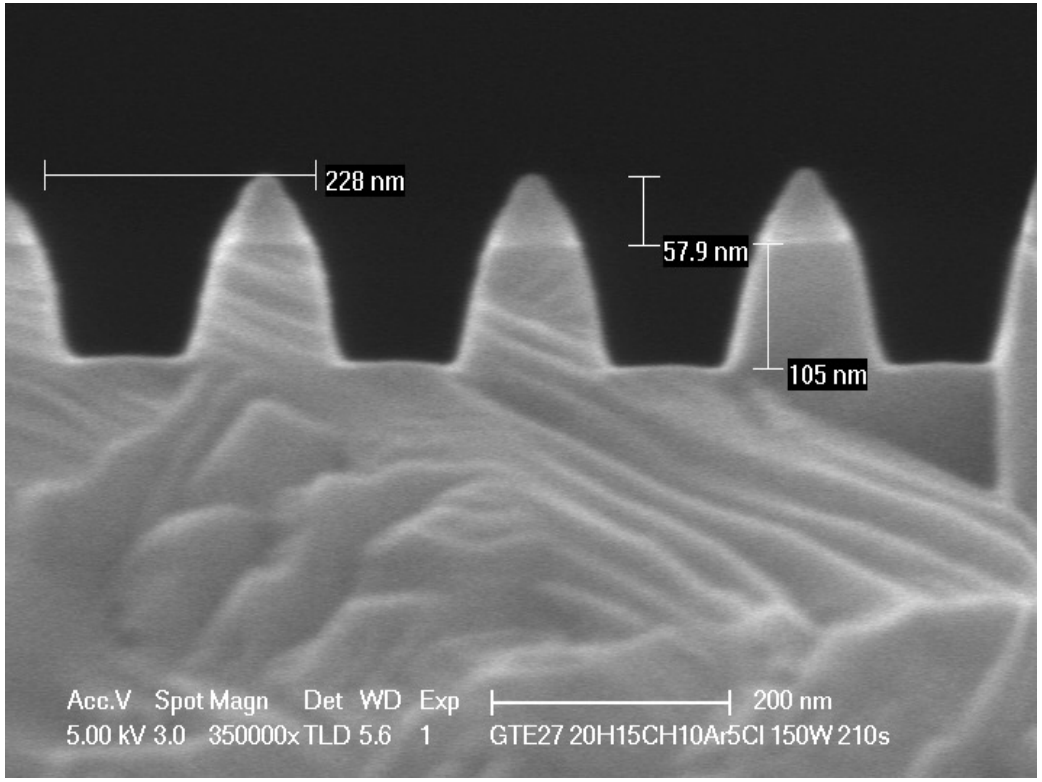
The "standard" InP Grating recipe:

"<u>Std InP Grating Etch - Cl2/CH4/H2/Ar 20C</u>"

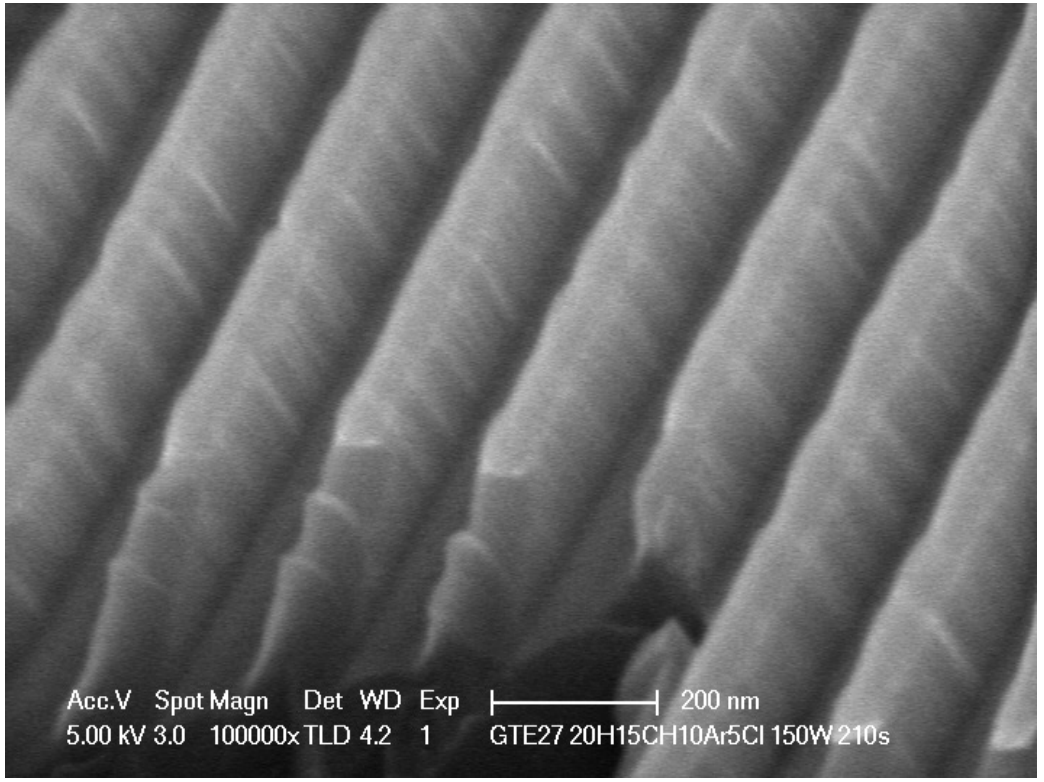
20°C table temp., 1cm piece on Si carrier, no mounting adhesive

2mT, RF=150W/ICP=100W; CH4=15/H2=20/Ar=10/Cl2=5 sccm; **3.5 min**

Sample from #4A, Etch rate=29.4 nm/min, sidewall angle=77.7 degree



Bottom surface is smooth



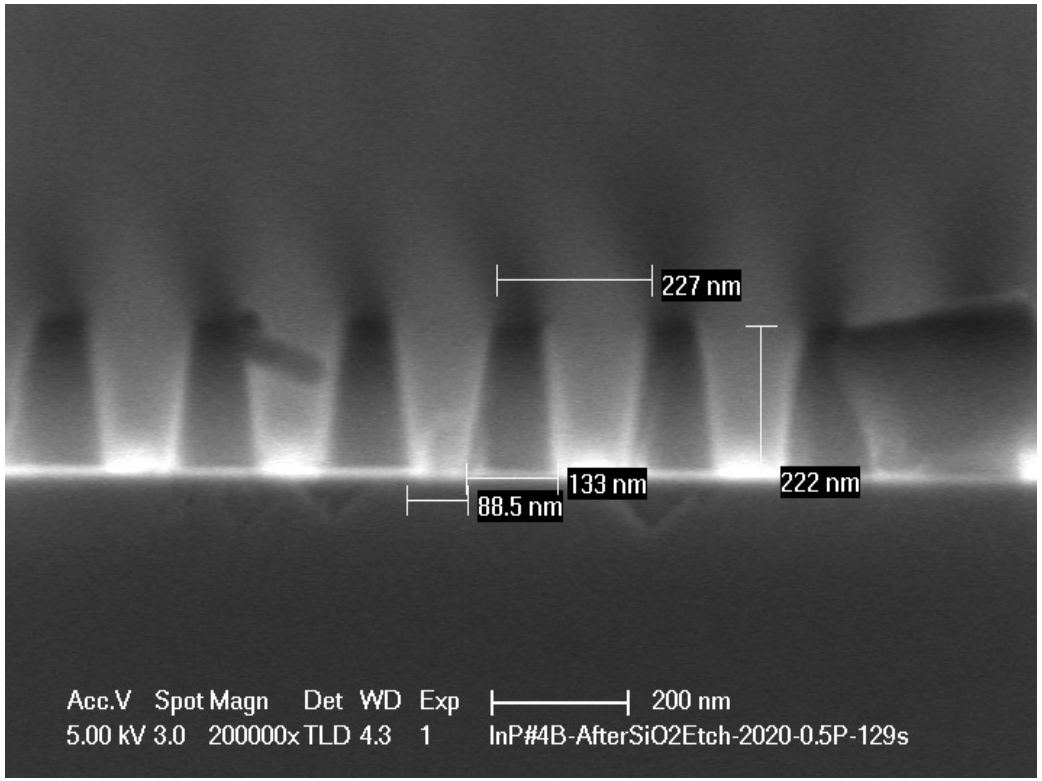
Recipe Variations in following slides

- Development process – 30 etches performed to achieve best result
- Targeting:
  - Slightly non-vertical grating sidewall, for regrowth
  - no micro-trenching
  - Smooth etched surfaces (no pillars/micromasking etc.)

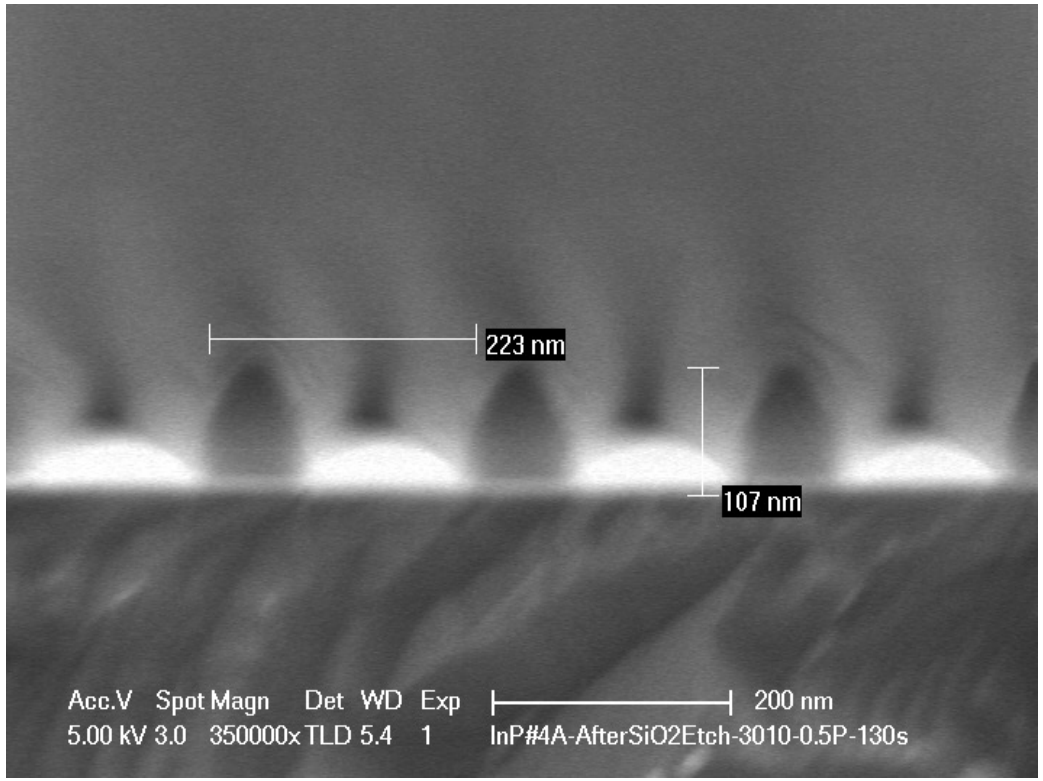
InP Grating Etch at 20 C, PlasmaPro 100 Cobra

InP pieces
SiO2 Hardmask patterned by Holography
100mm Silicon carrier wafer, no adhesive, rough side up

Grating Pattern (Holography and SiO2 Etch) Quarter#4B

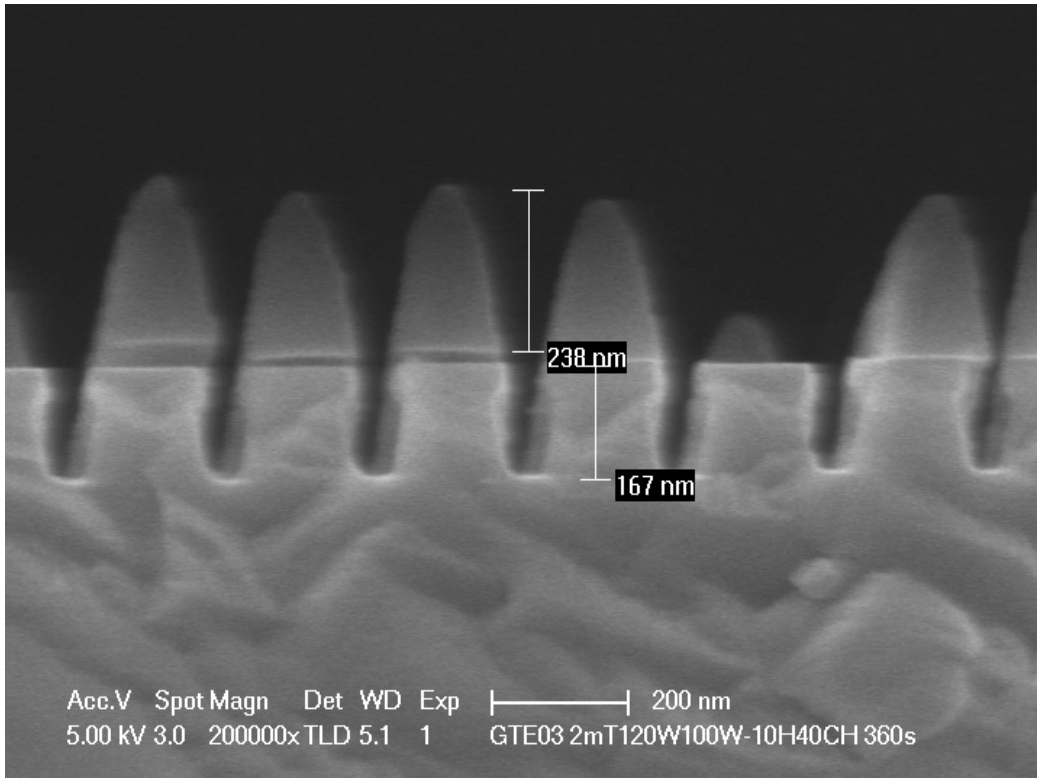


Grating Pattern (Holography and SiO2 Etch) Quarter#4A

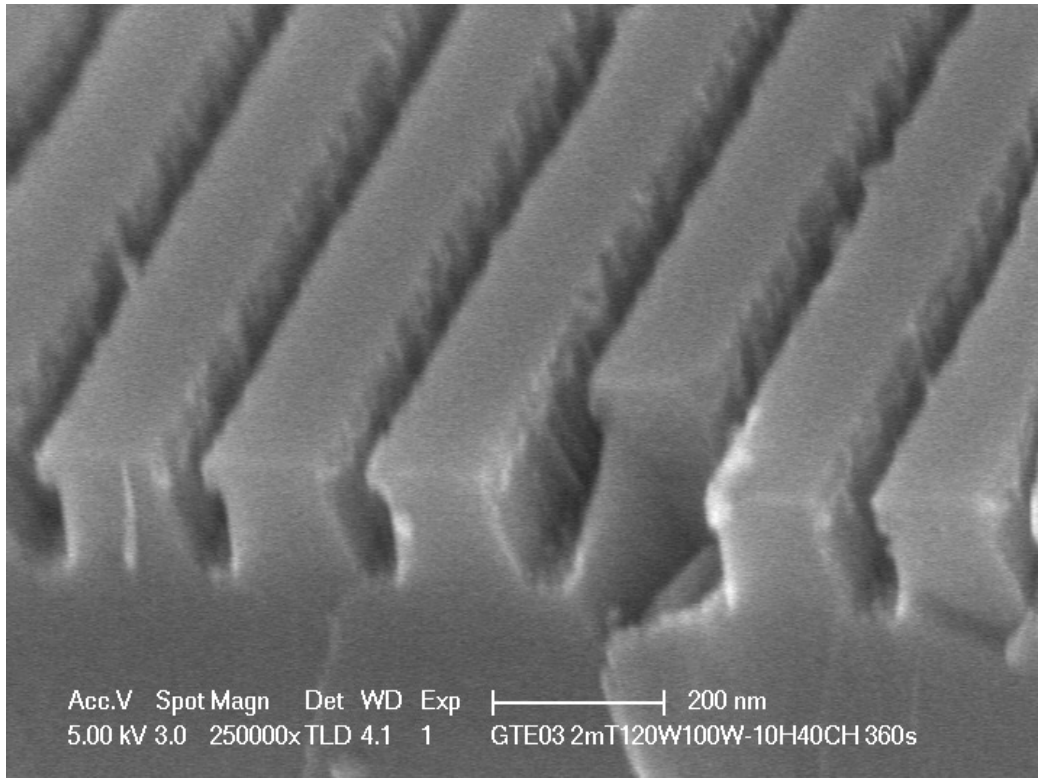


Oxford Recipe: 2mT, CH4/H2=40/10 sccm, 120W(Bias)-100W(ICP), 6 min

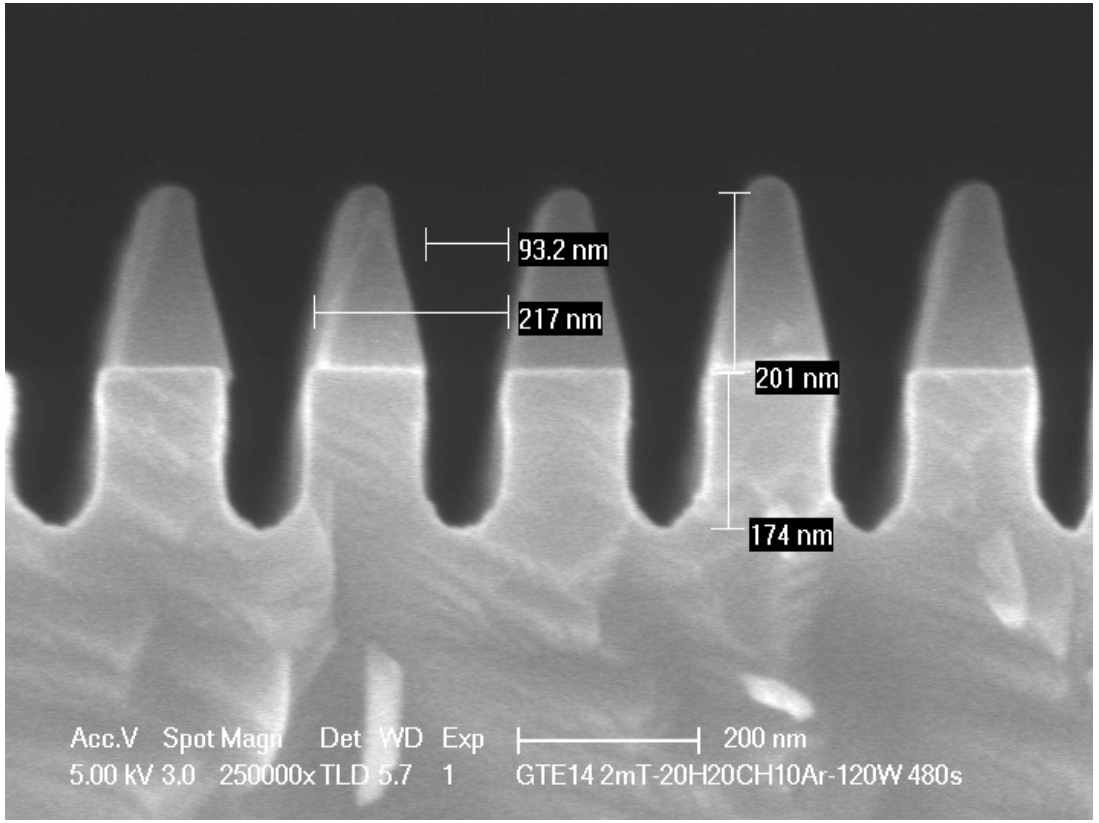
Using #4B

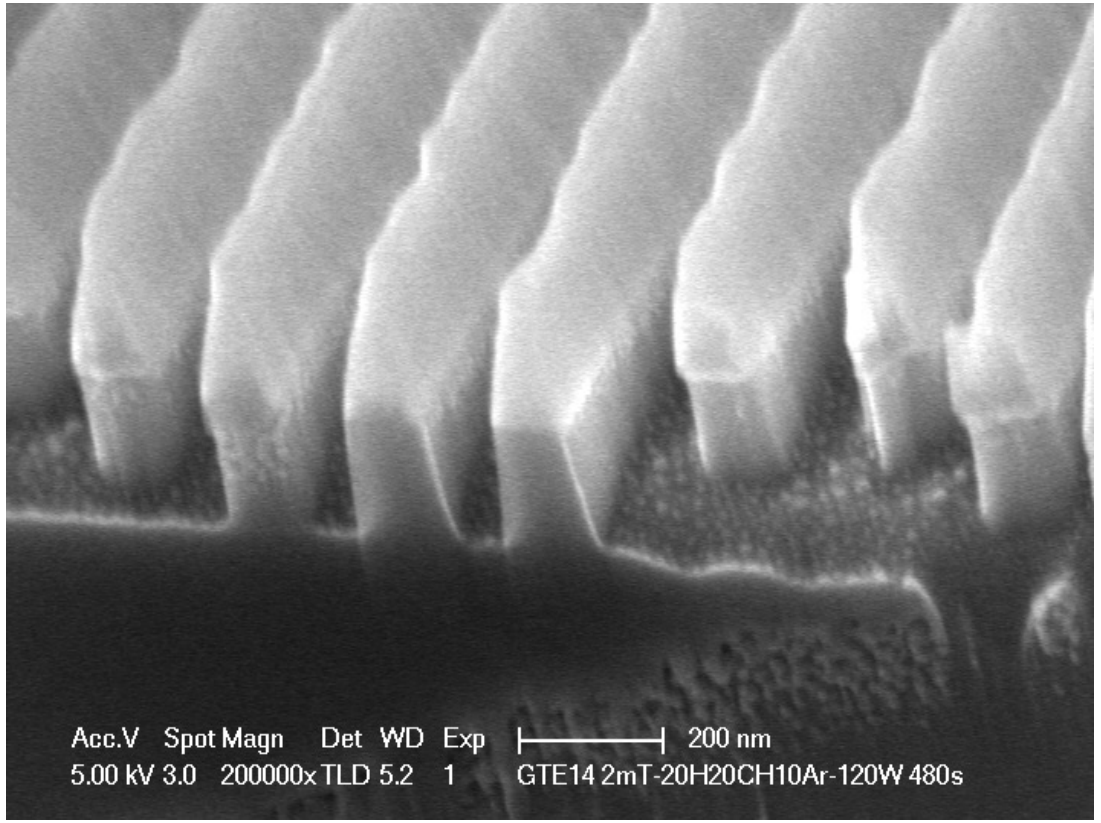


Issue: too much CH4, and polymer built up

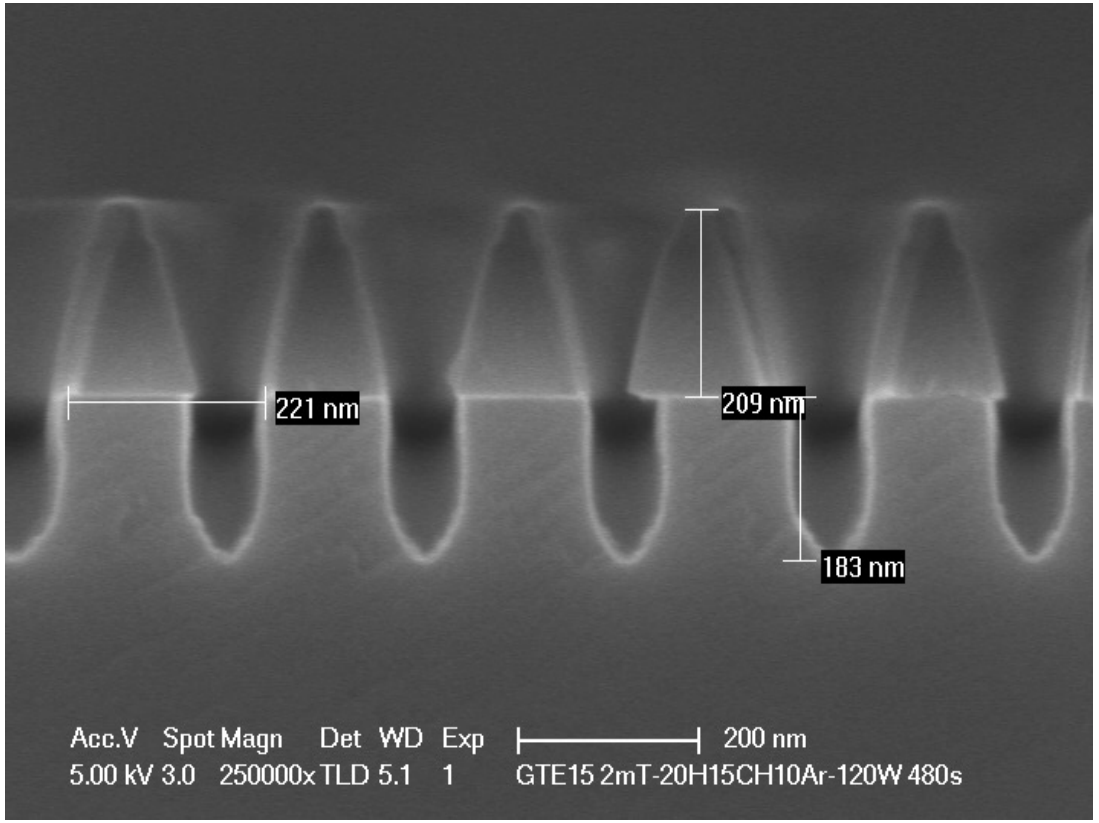


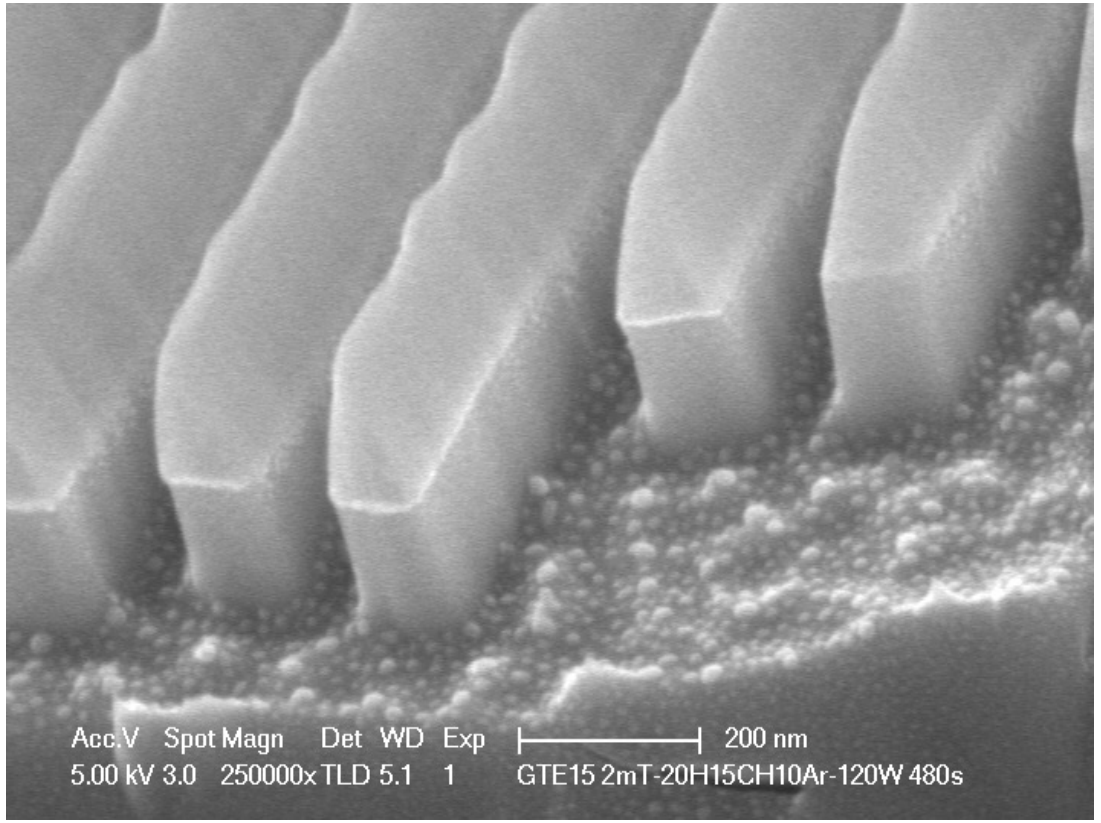
Reducing CH4: 2mT, 120W-100W, CH4/H2/Ar=20/20/10 sccm, 8 min





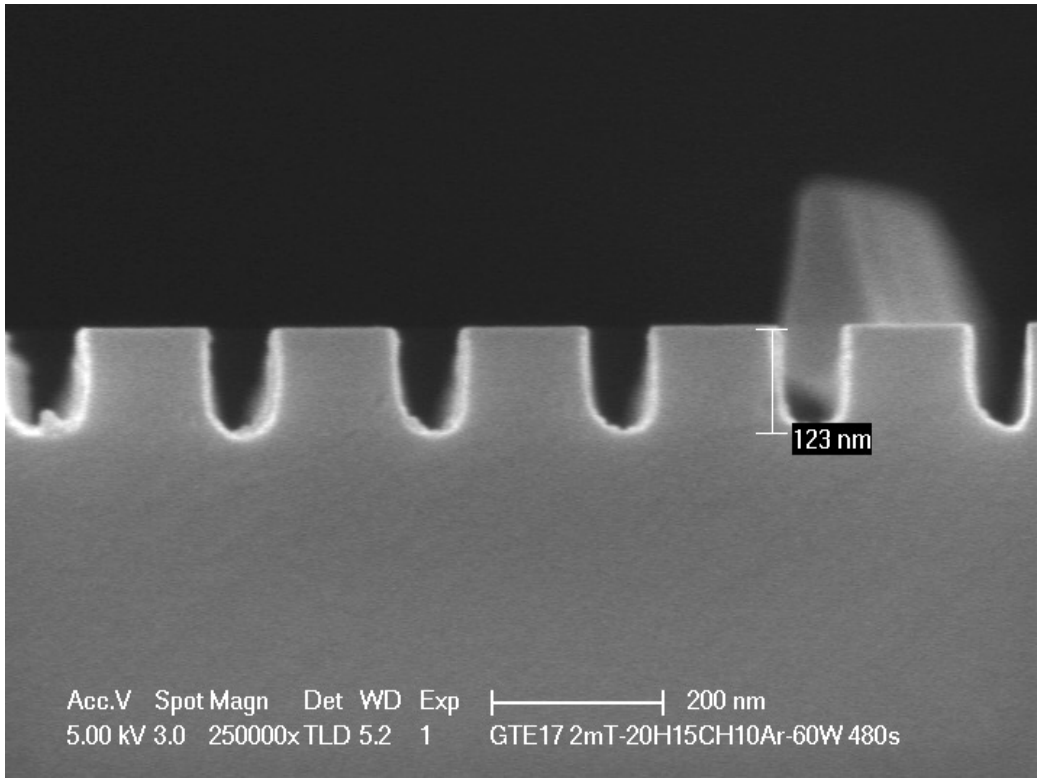
Further Reducing CH4: 2mT, 120W-100W, CH4/H2/Ar=15/20/10 sccm, 8 min

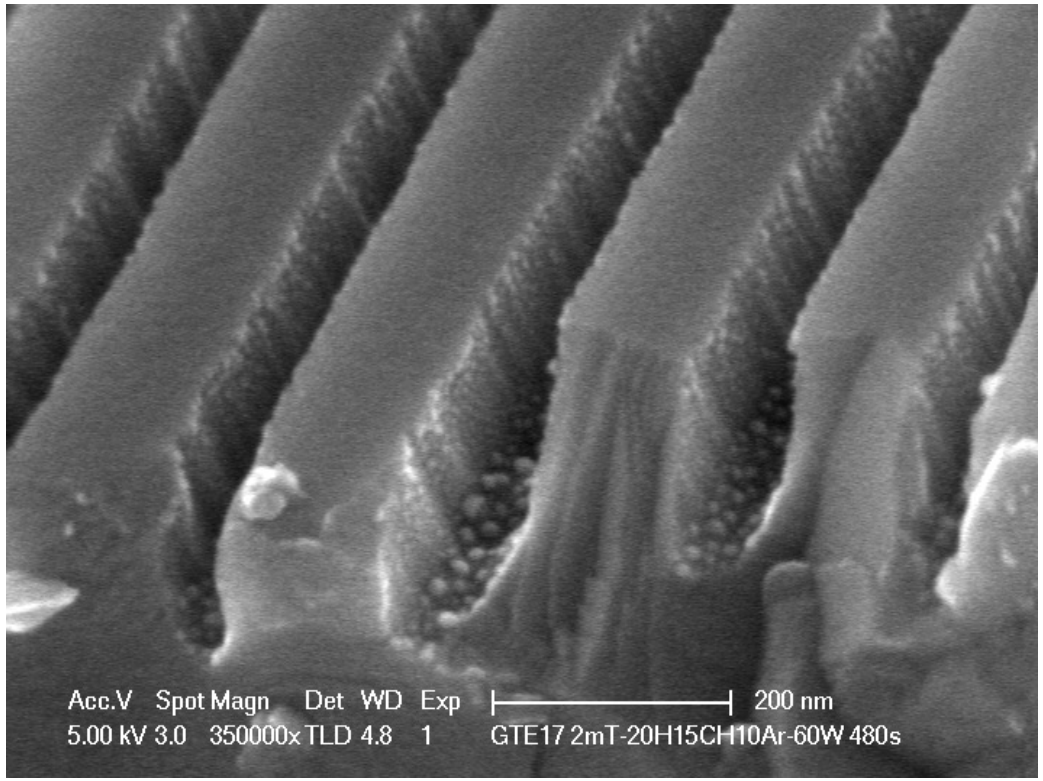




Reducing Bias: 2mT, 60W-100W, CH4/H2/Ar=15/20/10 sccm, 8 min

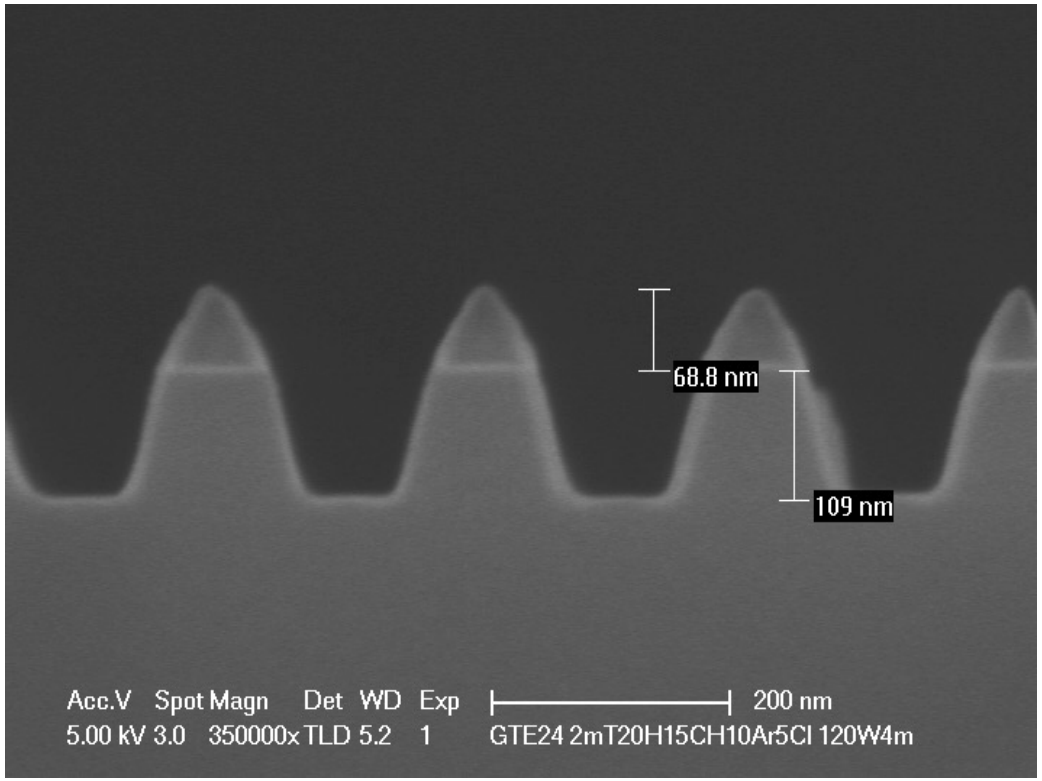
The bottom roughness still there!



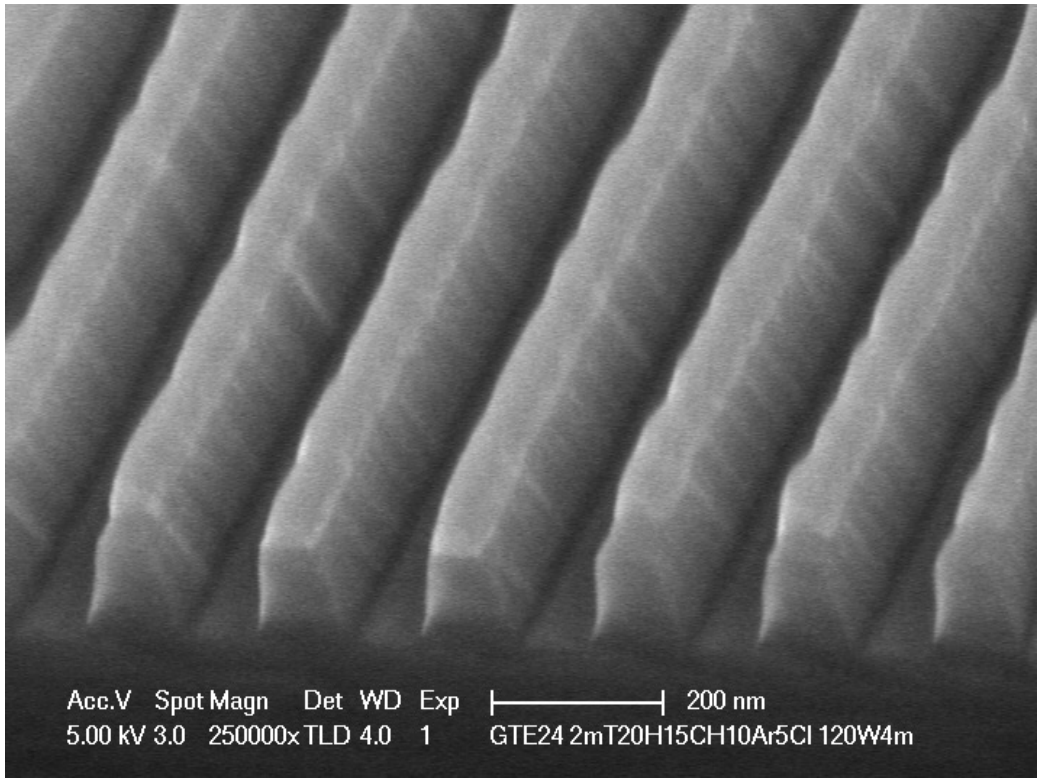


Adding Cl2: 2mT, 120W-100W, CH4/H2/Ar/Cl2=15/20/10/5 sccm, 4min

Sample from #4A, Etch Rate=27.6 nm/min, sidewall angle=74.4 degree



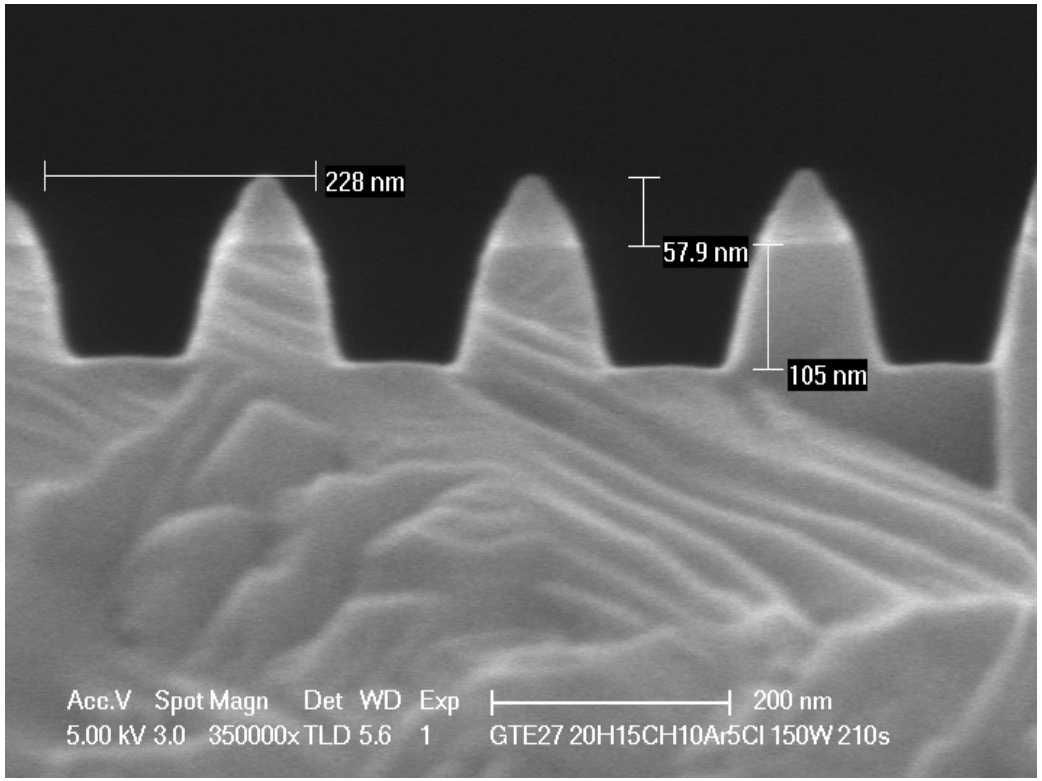
Bottom roughness gone!



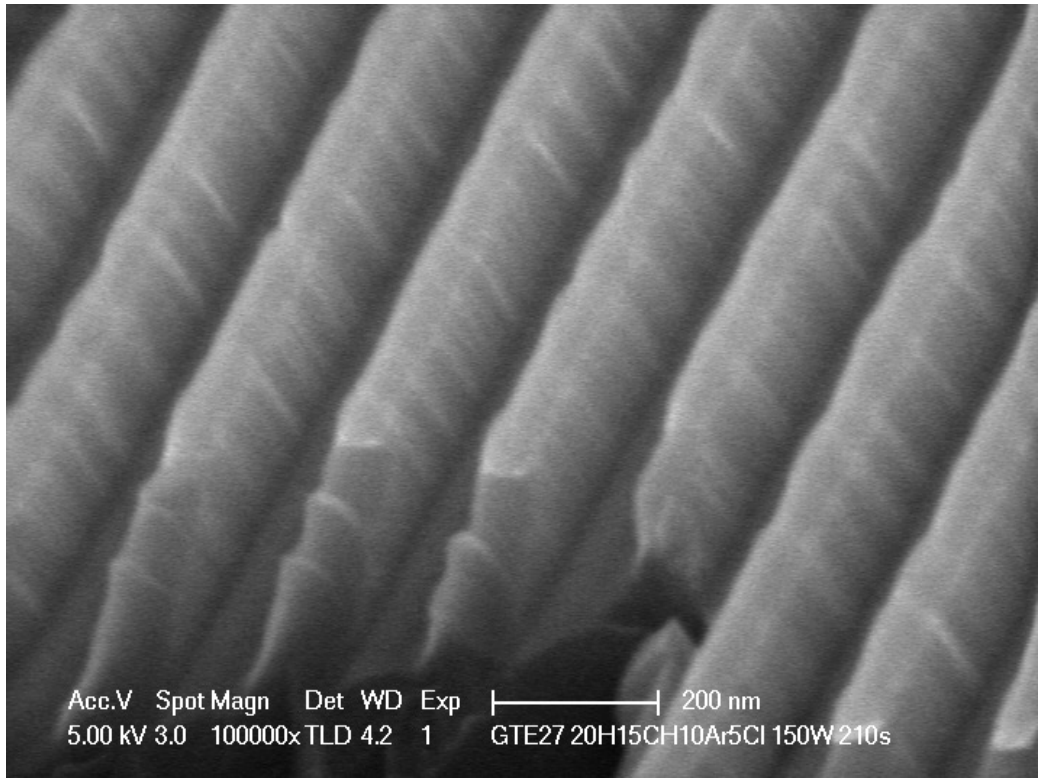
This is the "standard" InP Grating recipe

Increasing Bias: 2mT,150W-100W CH4/H2/Ar/Cl2=15/20/10/5 sccm, 3.5 min

Sample from #4A, Etch rate=29.4 nm/min, sidewall angle=77.7 degree

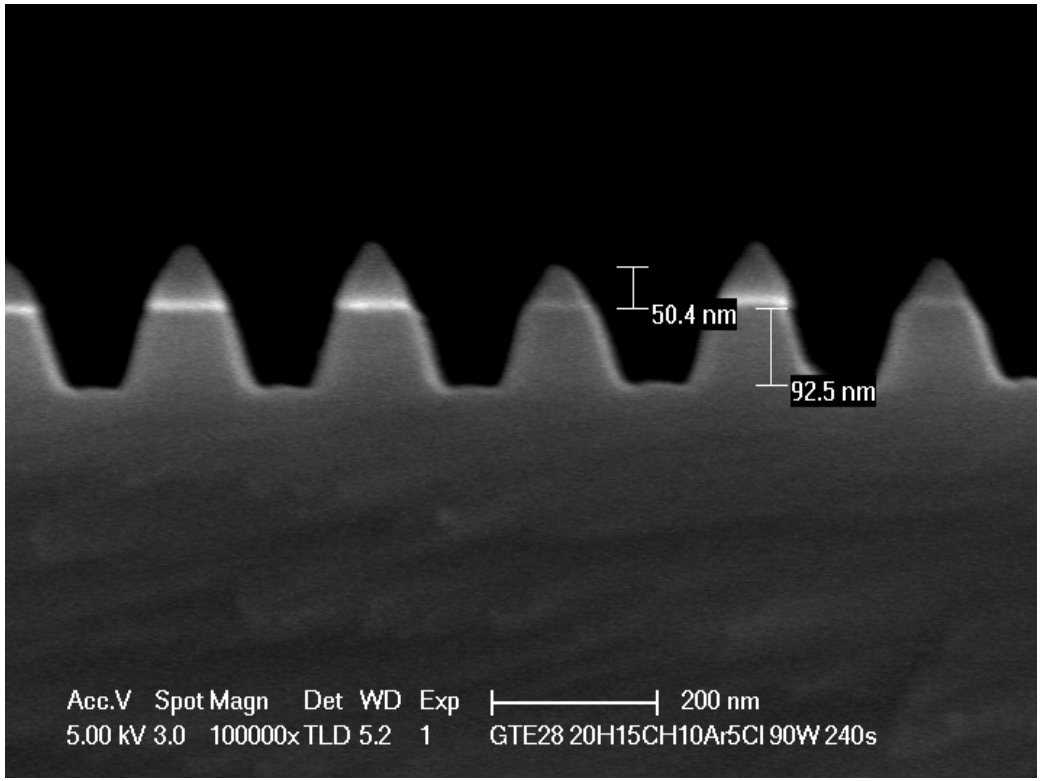


Bottom roughness gone!



Decreasing Bias: 2mT, 90W-100W, CH4/H2/Ar/Cl2=15/20/10/5 sccm, 4 min

Sample from #4A, Etch Rate=24.3 nm/min



Bottom roughness gone!