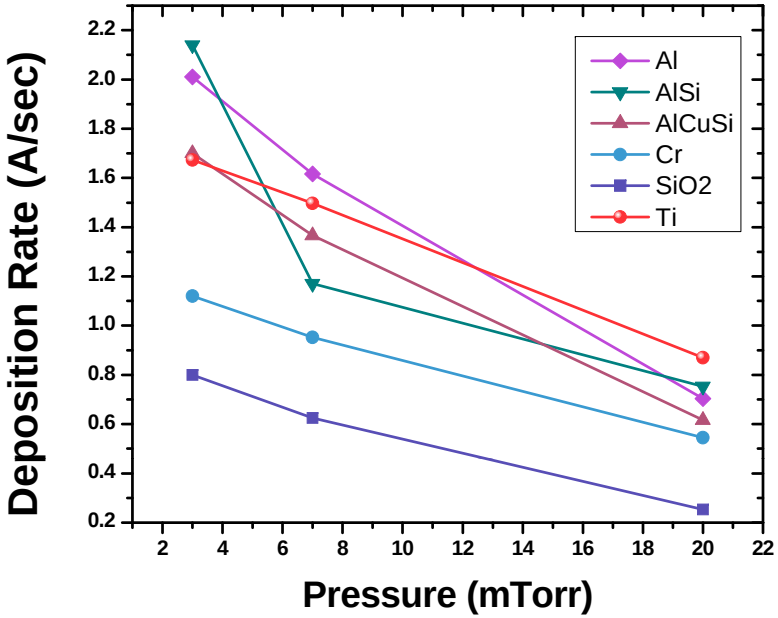
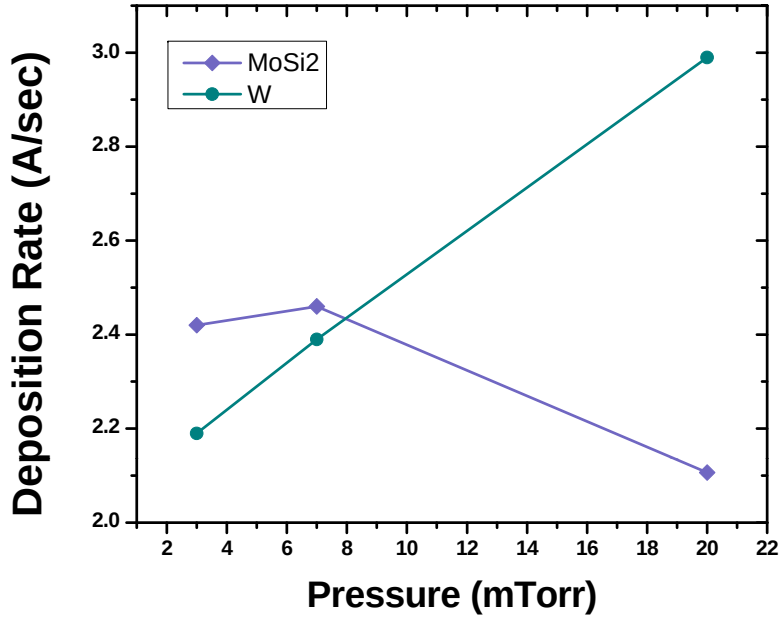
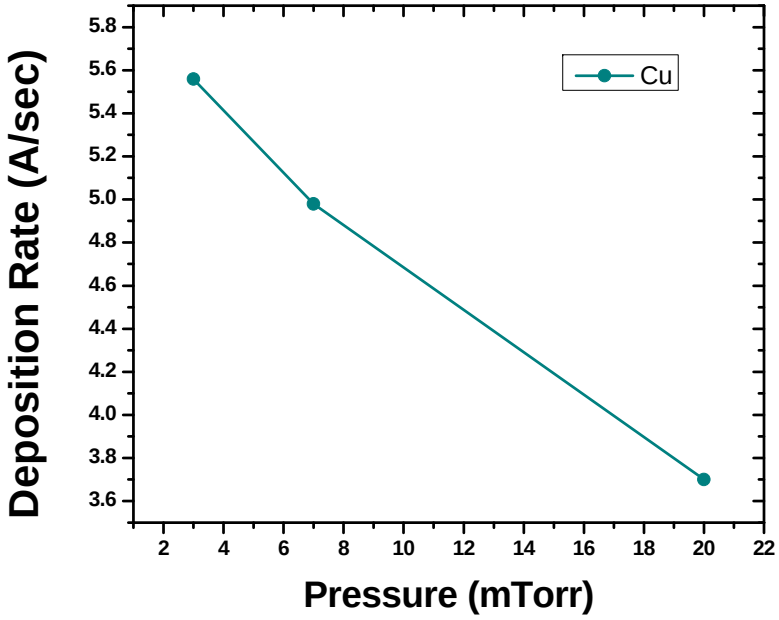
**Sputter Conditions: Full Rotation; Power = 400W; Presputter 20seconds; Ar flow - 30sccm**

| GUN # | Target | Sample ID | P (mTorr) | Time(sec) | Thickness (A) | Rate (A/sec) | Stress (MPa) | Stress | Page | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Al | AJA2-08 | 3 | 1000 | 2010 | 2.01 | -2.3 | C | 1 | |
| 3 | Al | AJA2-09 | 7 | 1200 | 1940 | 1.62 | -10.5 | C | 2 | |
| 3 | Al | AJA2-10 | 20 | 2500 | 1760 | 0.70 | -43.8 | C | 3 | |
| 3 | AlSi | AJA1-19 | 3 | 1000 | 2140 | 2.14 | -10.5 | C | 4 | |
| 3 | AlSi | AJA1-20 | 7 | 1000 | 1170 | 1.17 | 48.3 | T | 5 | |
| 3 | AlSi | AJA1-21 | 20 | 1500 | 1130 | 0.75 | 0.7 | T | 6 | |
| 3 | AlCuSi | AJA2-16 | 3 | 1000 | 1732 | 1.73 | -24.4 | C | 7 | |
| 3 | AlCuSi | AJA2-17 | 3 | 1500 | 2506 | 1.67 | -20.6 | C | 8 | |
| 3 | AlCuSi | AJA2-18 | 7 | 1500 | 2050 | 1.37 | 13.5 | T | 9 | |
| 3 | AlCuSi | AJA2-19 | 20 | 2000 | 1232 | 0.62 | 41.8 | T | 10 | |
| 1 | Cr | AJA1-16 | 3 | 1000 | 1120 | 1.12 | 569.6 | T | 11 | |
| 1 | Cr | AJA1-17 | 7 | 1250 | 1190 | 0.95 | 177.3 | T | 12 | |
| 1 | Cr | AJA1-18 | 20 | 2000 | 1090 | 0.55 | 152.8 | T | 13 | |
| 2 | Cu | AJA2-05 | 3 | 500 | 2780 | 5.56 | 107.5 | T | 14 | |
| 2 | Cu | AJA2-06 | 7 | 500 | 2490 | 4.98 | 140.4 | T | 15 | |
| 2 | Cu | AJA2-07 | 20 | 500 | 1850 | 3.70 | 186.5 | T | 16 | |
| 5 | MoSi2 | AJA1-22 | 3 | 2000 | 4840 | 2.42 | 420.5 | T | 17 | |
| 5 | MoSi2 | AJA1-23 | 7 | 1500 | 3690 | 2.46 | -334.9 | C | 18 | |
| 5 | MoSi2 | AJA1-24 | 20 | 1500 | 3160 | 2.11 | -122.1 | C | 19 | |
| 4 | SiO2 | AJA1-10 | 3 | 3600 | 2700 | 0.75 | -84.2 | C | 20 | |
| 4 | SiO2 | AJA1-25 | 3 | 3600 | 3080 | 0.86 | -73 | C | 21 | |
| 4 | SiO2 | AJA1-11 | 7 | 4500 | 2630 | 0.58 | -45.5 | C | 22 | |
| 4 | SiO2 | AJA2-01 | 7 | 4000 | 2680 | 0.67 | -33.7 | C | 23 | |
| 4 | SiO2 | AJA1-12 | 20 | 4500 | 1140 | 0.25 | -178 | C | 24 | |
| 1 | Ti | AJA2-02 | 3 | 1500 | 2510 | 1.67 | -15.2 | C | 25 | |
| 1 | Ti | AJA2-03 | 7 | 1750 | 2620 | 1.50 | 74.5 | T | 26 | |
| 1 | Ti | AJA2-04 | 20 | 3600 | 3130 | 0.87 | 68.4 | T | 27 | |
| 5 | W | AJA2-11 | 3 | 1000 | 2190 | 2.19 | -2830 | C | 28 | |
| 5 | W | AJA2-12 | 7 | 1000 | 2390 | 2.39 | 1759 | T | 29 | Resist Burns |
| 5 | W | AJA2-13 | 20 | 1000 | 2990 | 2.99 | -295 | C | 30 | Resist Burns |

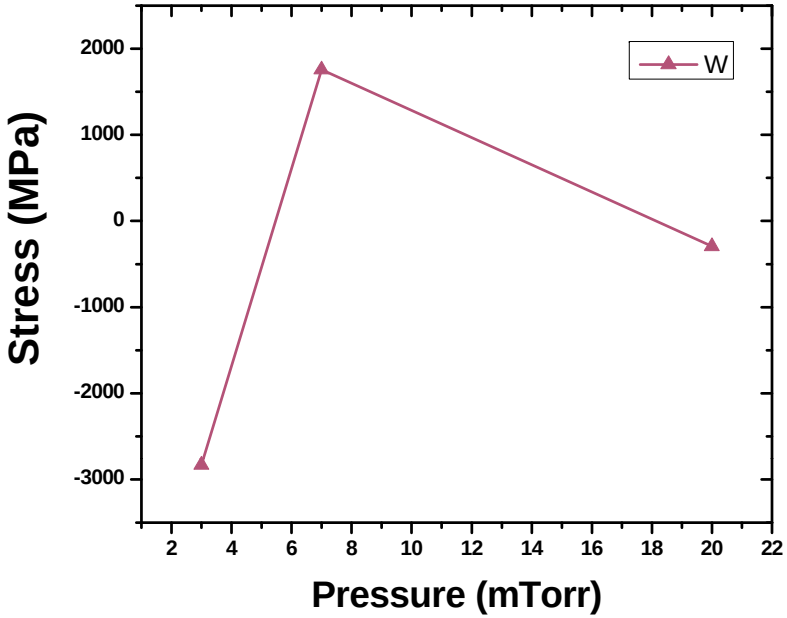
# DEPOSITION RATE VS. PRESSURE

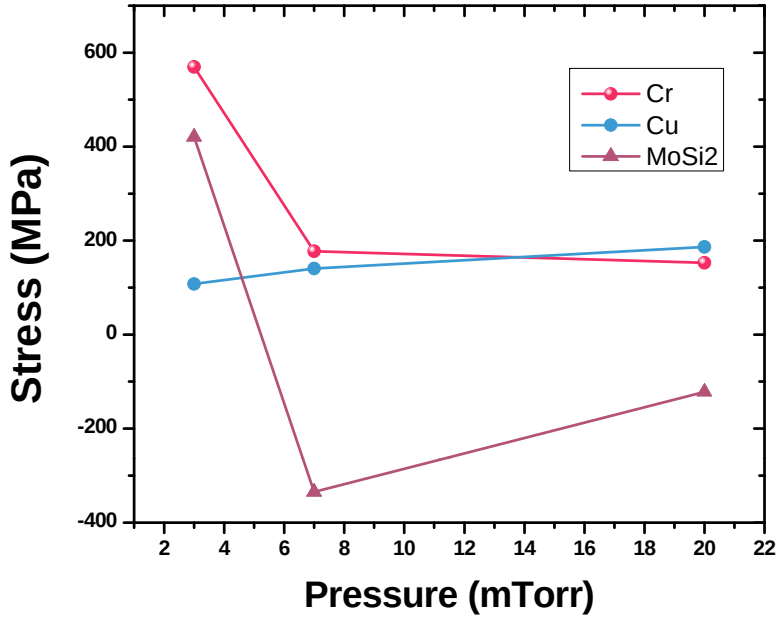


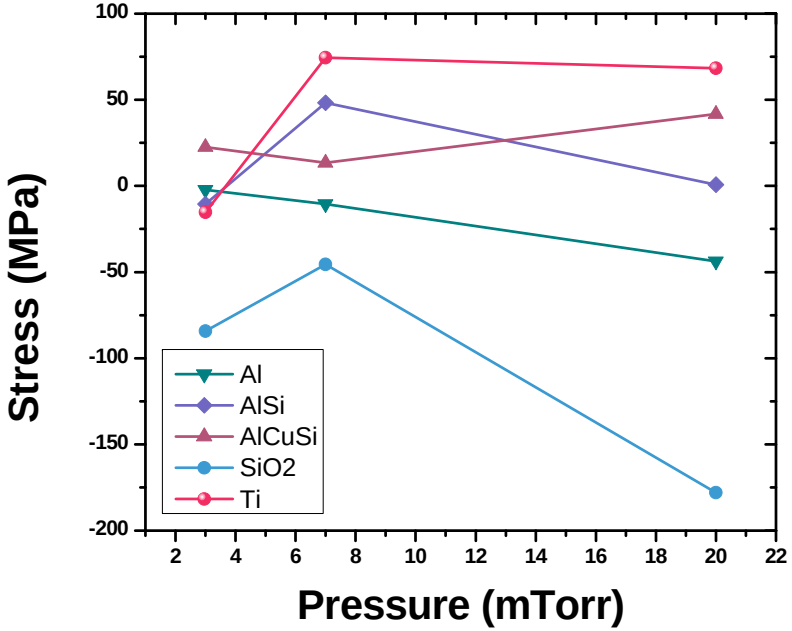



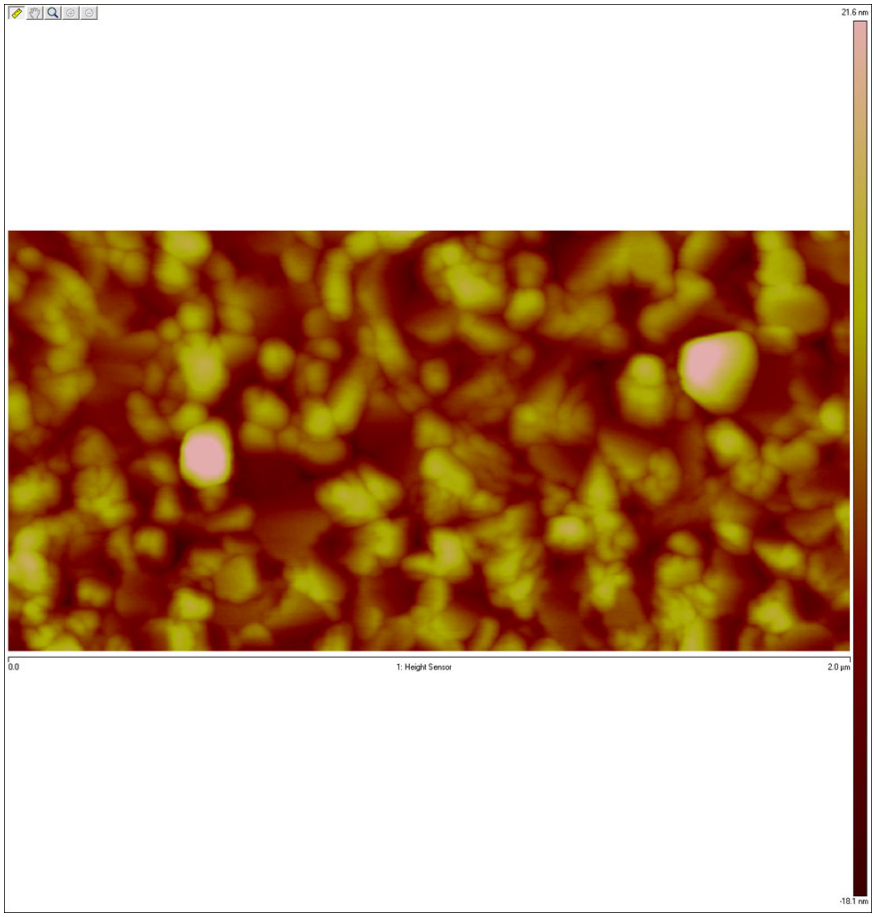
# STRESS VS. PRESSURE



# AJA2-08 - Al



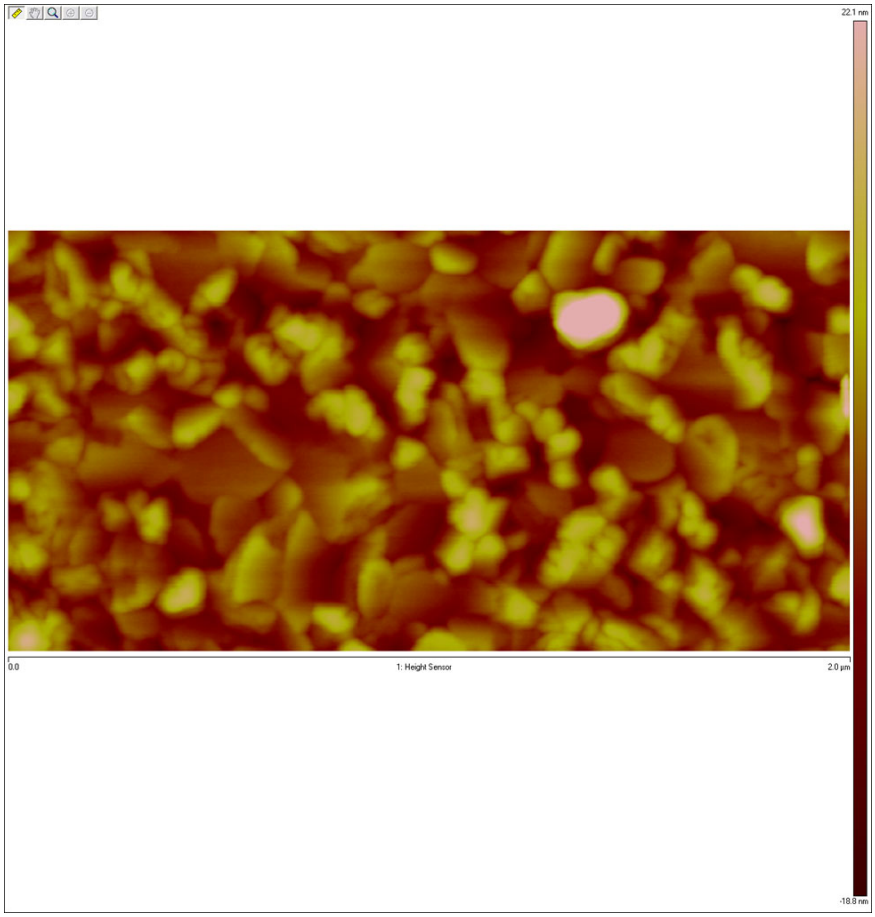

**Material: Al** **Sample ID: AJA2-08**

Pressure: 3 mTorr Time: 1000 sec Thickness: 2010 A Rate: 2.01 A/sec

Stress = -2.3 MPa (Compressive)

Roughness: Rq = 5.49 nm Ra = 4.25 nm Rmax = 50.9 nm

# AJA2-09 - Al



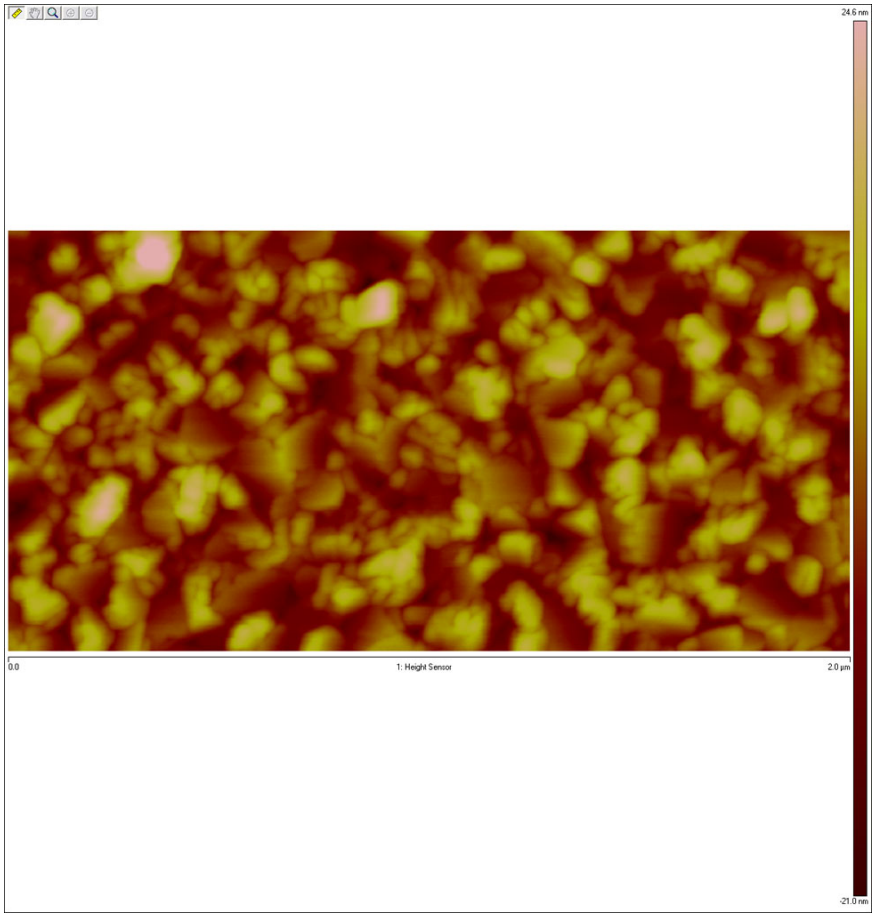

**Material: Al** **Sample ID: AJA2-09**

Pressure: 7 mTorr Time: 1200 sec Thickness: 1940 A Rate: 1.62 A/sec

Stress = -10.5 MPa (Compressive)

Roughness: Rq = 5.59 nm Ra = 4.2 nm Rmax = 57.3 nm

## AJA2-10 - Al



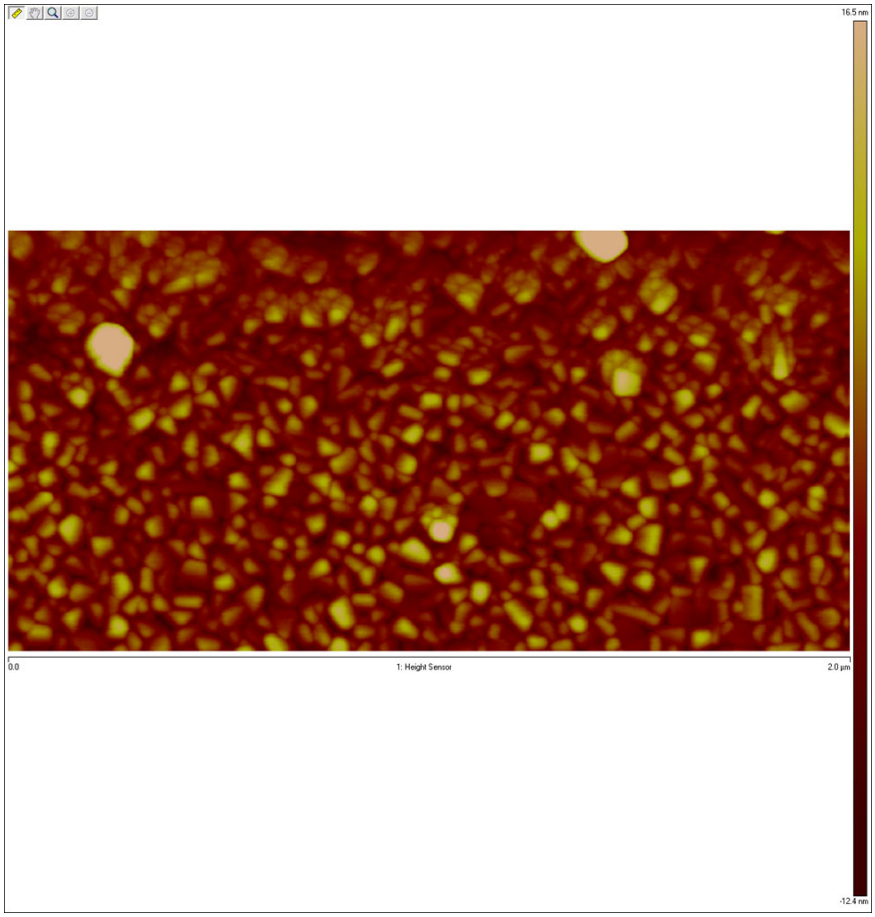

**Material: Al** **Sample ID: AJA2-10**

Pressure: 20 mTorr Time: 2500 sec Thickness: 1760 A Rate: 0.70 A/sec

Stress = -43.8 MPa (Compressive)

Roughness: Rq = 6.45 nm Ra = 5.1 nm Rmax = 57.9 nm

## AJA1-19 - AlSi



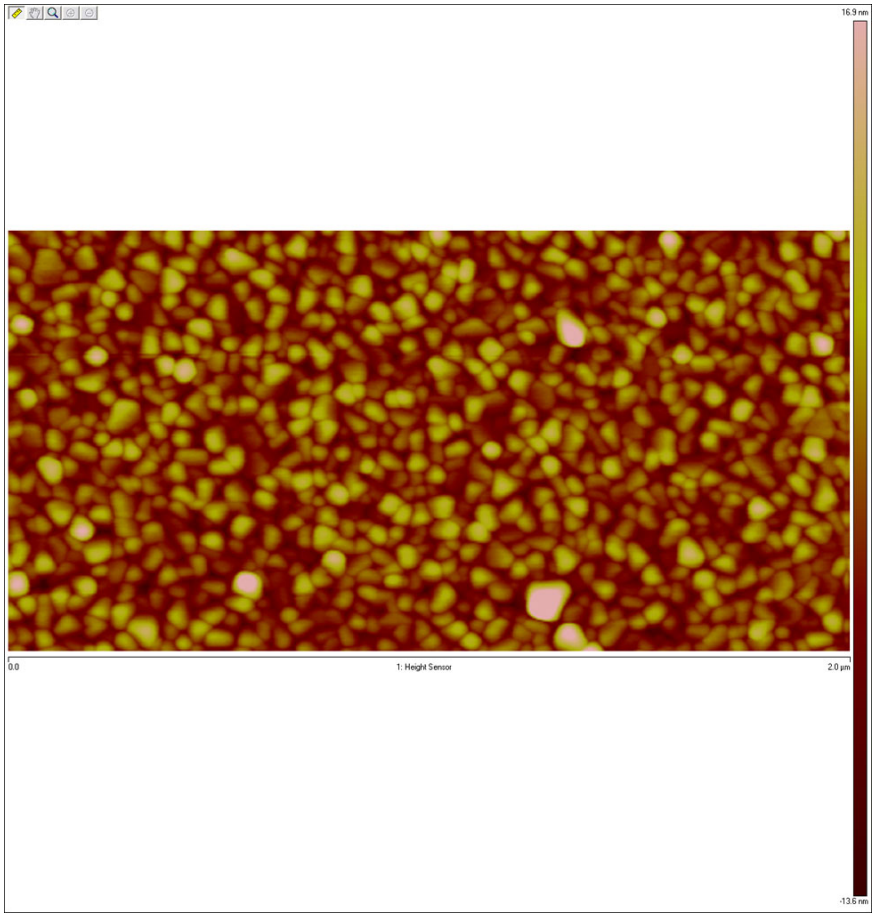

**Material: AlSi** **Sample ID: AJA1-19**

Pressure: 3 mTorr Time: 1000 sec Thickness: 2140 A Rate: 2.14 A/sec

Stress = -10.5 MPa (Compressive)

Roughness: Rq = 4.07 nm Ra = 3.06 nm Rmax = 42.6 nm

## AJA1-20 - AlSi



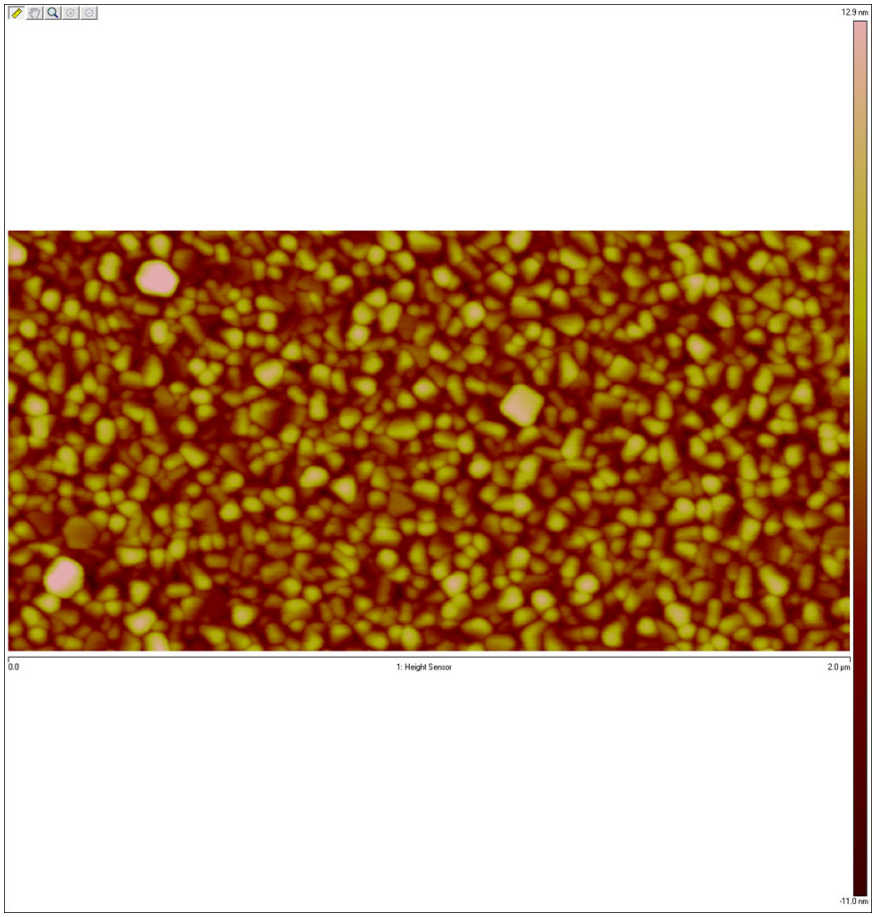

**Material: AlSi** **Sample ID: AJA1-20**

Pressure: 7 mTorr Time: 1000 sec Thickness: 1170 A Rate: 1.17 A/sec

Stress = 48.3 MPa (Tensile)

Roughness: Rq = 4.3 nm Ra = 3.31 nm Rmax = 50.2 nm

## AJA1-21 - AlSi



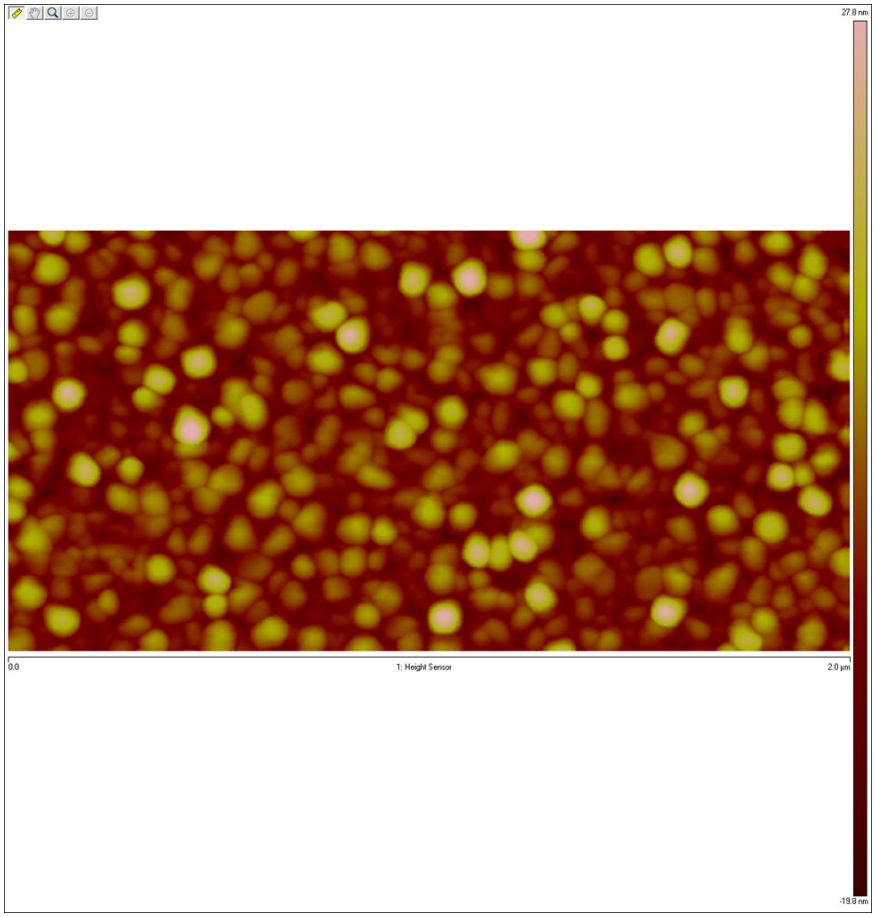

**Material: AlSi** **Sample ID: AJA1-21**

Pressure: 20 mTorr Time: 1500 sec Thickness: 1130 A Rate: 0.75 A/sec

Stress = 0.7 MPa (Tensile)

Roughness: Rq = 3.39 nm Ra = 2.67 nm Rmax = 31.1 nm

## AJA2-16 - AlCuSi




**Material: AlCuSi** **Sample ID: AJA2-16**

Pressure: 3 mTorr Time: 1000 sec Thickness: 1732 A Rate: 1.73 A/sec

Stress = -24.4 MPa (Compressive)

Roughness: Rq = 6.42 nm Ra = 4.95 nm Rmax = 50.9 nm

# AJA2-17 - AlCuSi

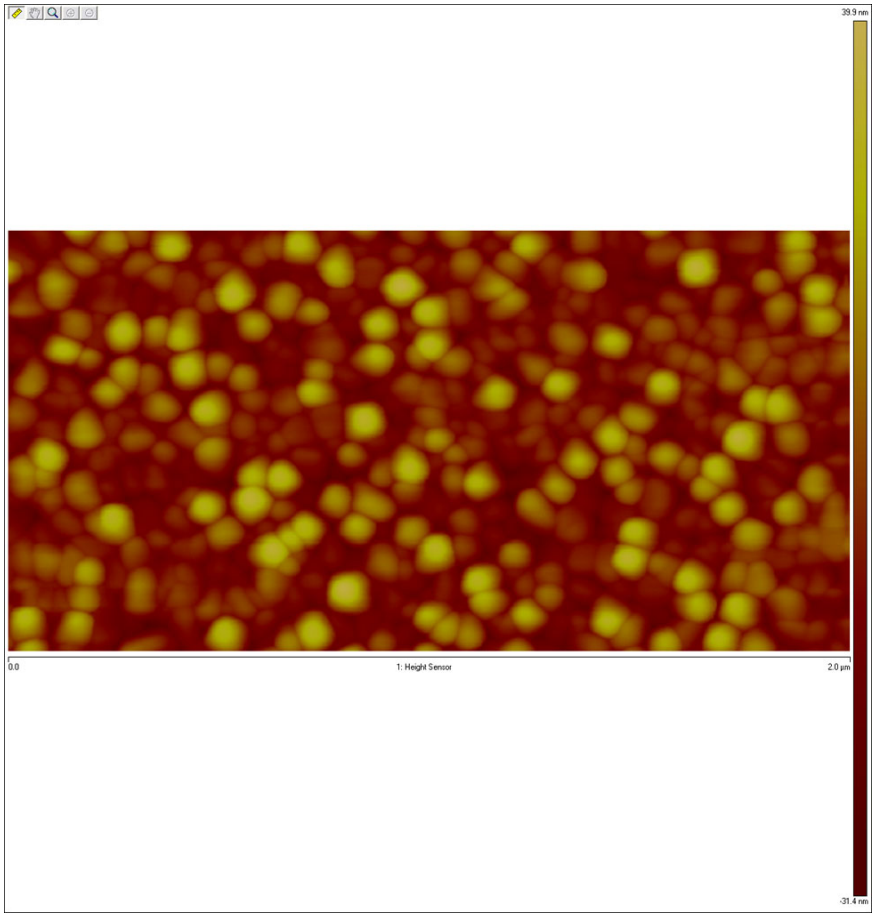
**Material: AlCuSi** **Sample ID: AJA2-17**

Pressure: 3 mTorr Time: 1500 sec Thickness: 2506 A Rate: 1.67 A/sec

Stress = -20.6 MPa (Compressive)

Roughness: Rq = NA nm Ra = NA nm Rmax = NA nm

## AJA2-18 - AlCuSi



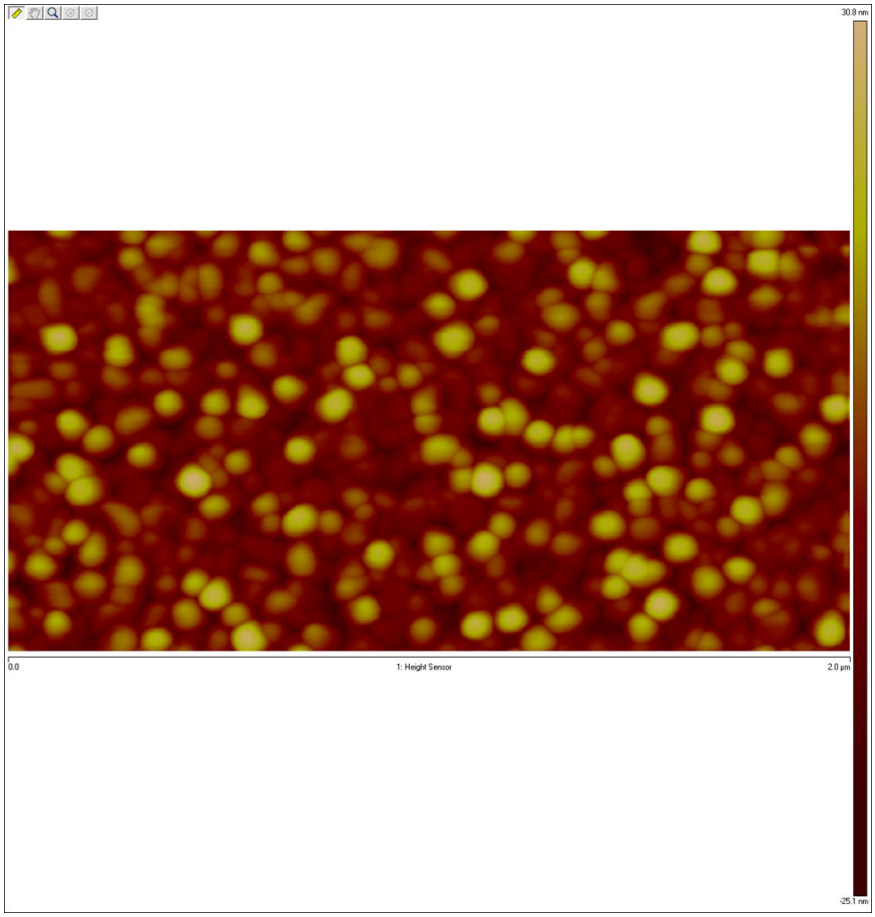

**Material: AlCuSi** **Sample ID: AJA2-18**

Pressure: 7 mTorr Time: 1500 sec Thickness: 2050 A Rate: 1.37 A/sec

Stress = 13.5 MPa (Tensile)

Roughness: Rq = 10.9 nm Ra = 8.71 nm Rmax = 68.9 nm

## AJA2-19 - AlCuSi



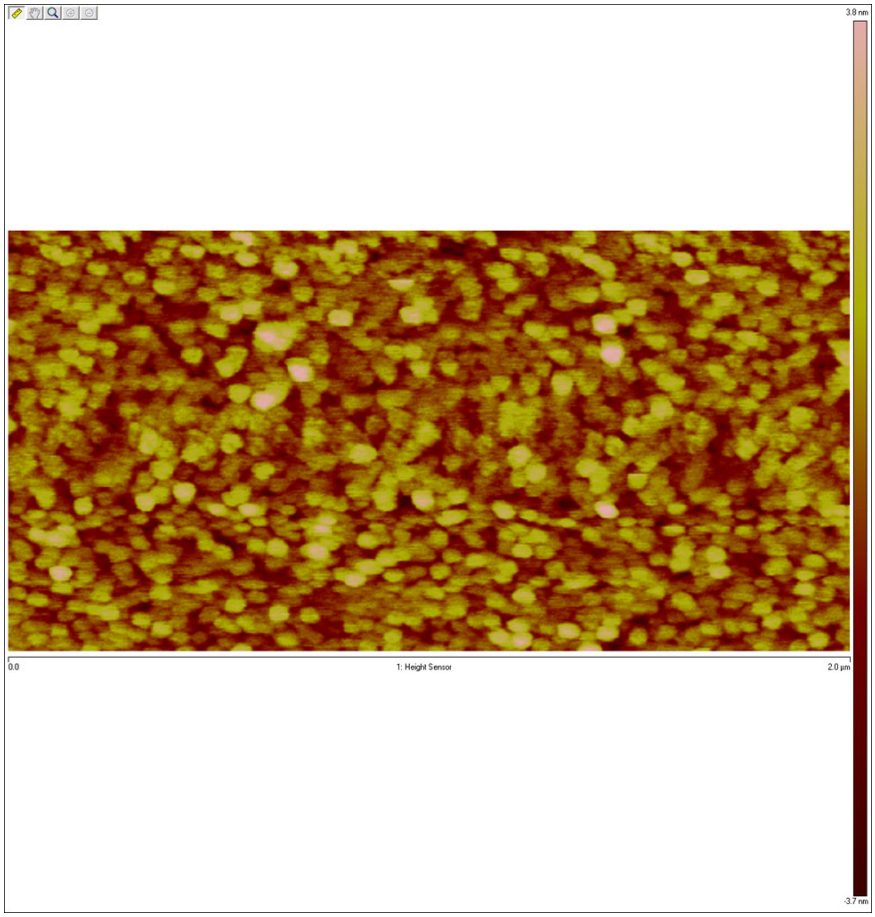

**Material: AlCuSi** **Sample ID: AJA2-19**

Pressure: 20 mTorr Time: 2000 sec Thickness: 1232 A Rate: 0.62 A/sec

Stress = 41.8 MPa (Tensile)

Roughness: Rq = 8.2 nm Ra = 6.55 nm Rmax = 53.2 nm

## AJA1-16 - Cr



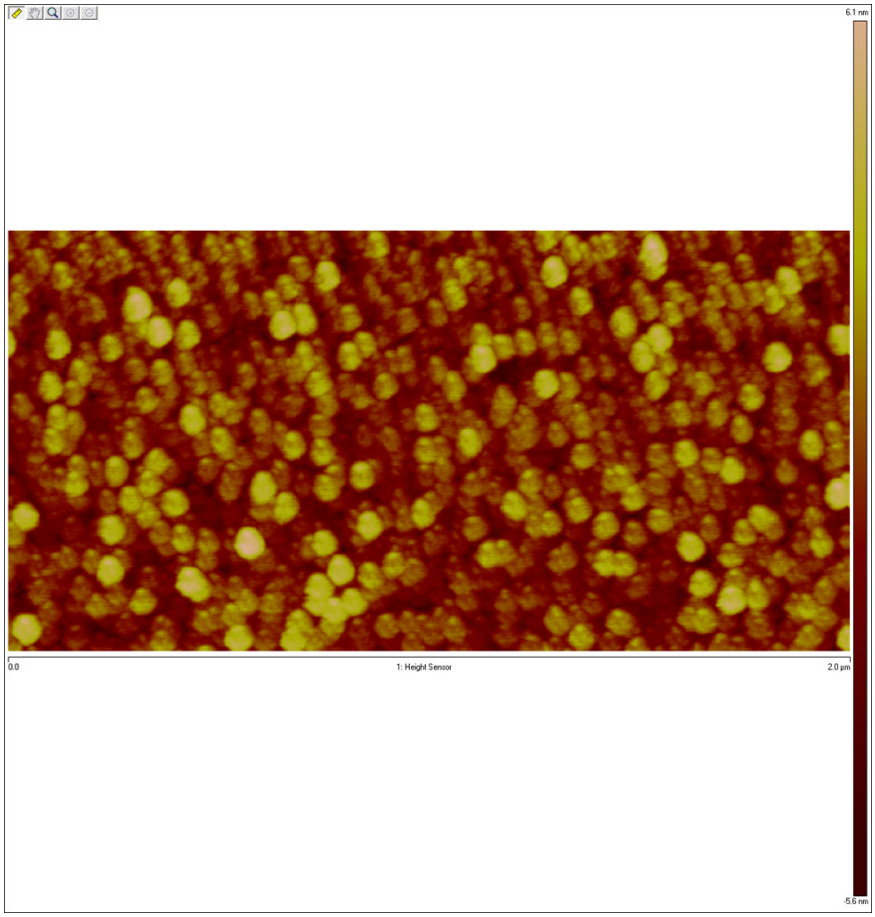

**Material: Cr** **Sample ID: AJA1-16**

Pressure: 3 mTorr Time: 1000 sec Thickness: 1120 A Rate: 1.12 A/sec

Stress = 569.6 MPa (Tensile)

Roughness: Rq = 1.02 nm Ra = 0.803 nm Rmax = 9.06 nm

## AJA1-17 - Cr



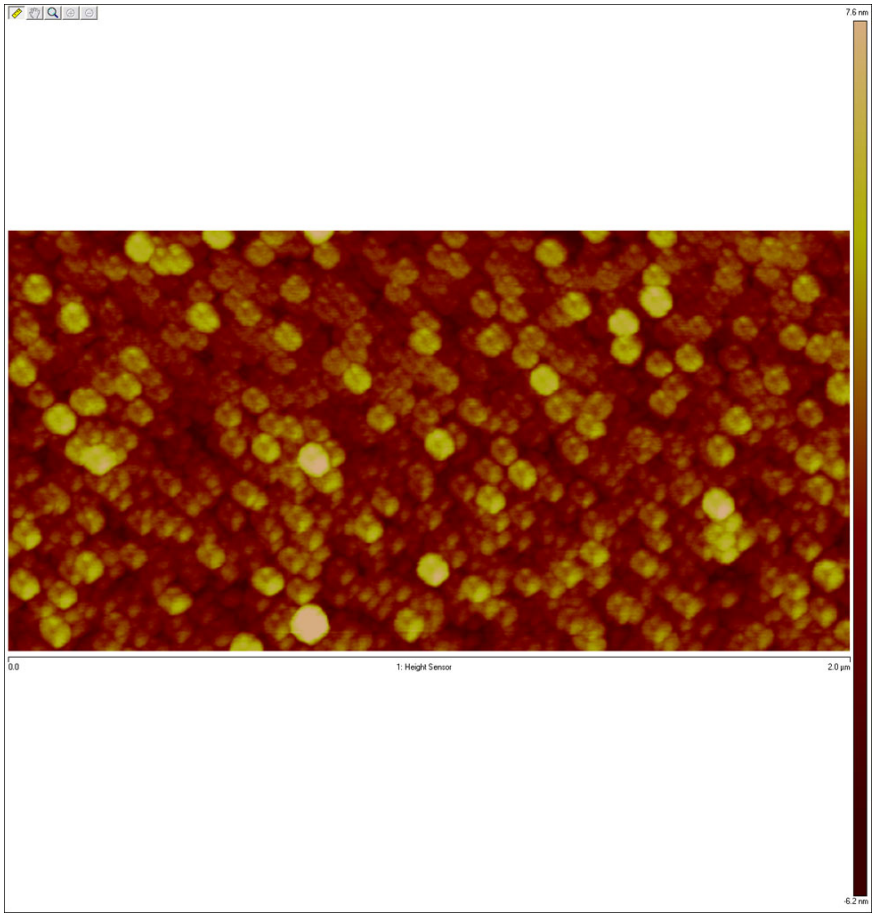

**Material: Cr** **Sample ID: AJA1-17**

Pressure: 7 mTorr Time: 1250 sec Thickness: 1190 A Rate: 0.95 A/sec

Stress = 177.3 MPa (Tensile)

Roughness: Rq = 1.68 nm Ra = 1.33 nm Rmax = 12.3 nm

## AJA1-18 - Cr



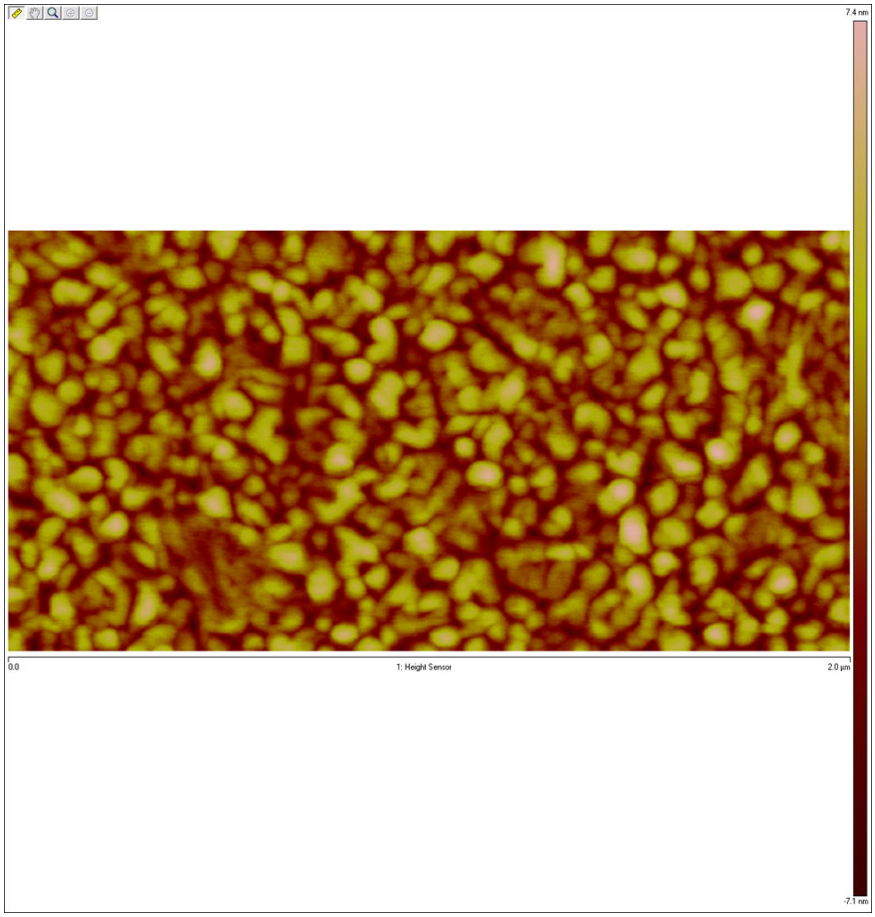

**Material: Cr** **Sample ID: AJA1-18**

Pressure: 20 mTorr Time: 2000 sec Thickness: 1090 A Rate: 0.55 A/sec

Stress = 152.8 MPa (Tensile)

Roughness: Rq = 1.9 nm Ra = 1.48 nm Rmax = 17.5 nm

## AJA2-05 - Cu



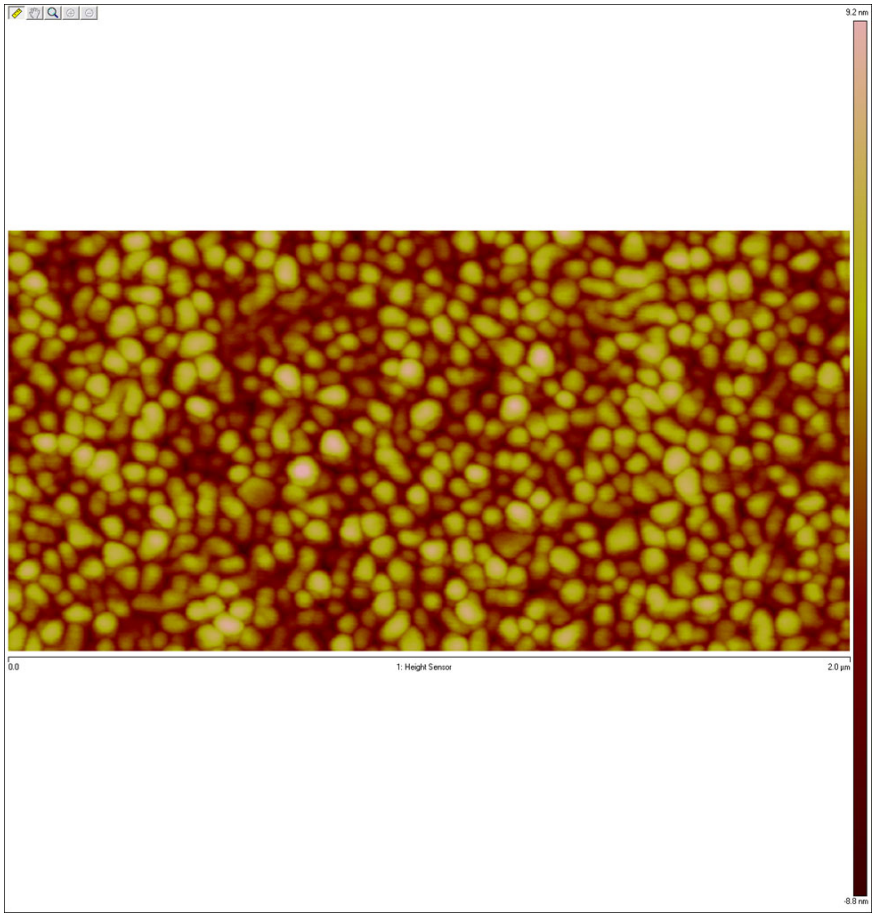

**Material: Cu** **Sample ID: AJA2-05**

Pressure: 3 mTorr Time: 500 sec Thickness: 2780 A Rate: 5.56 A/sec

Stress = 107.5 MPa (Tensile)

Roughness: Rq = 2.07 nm Ra = 1.65 nm Rmax = 14.5 nm

## AJA2-06 - Cu



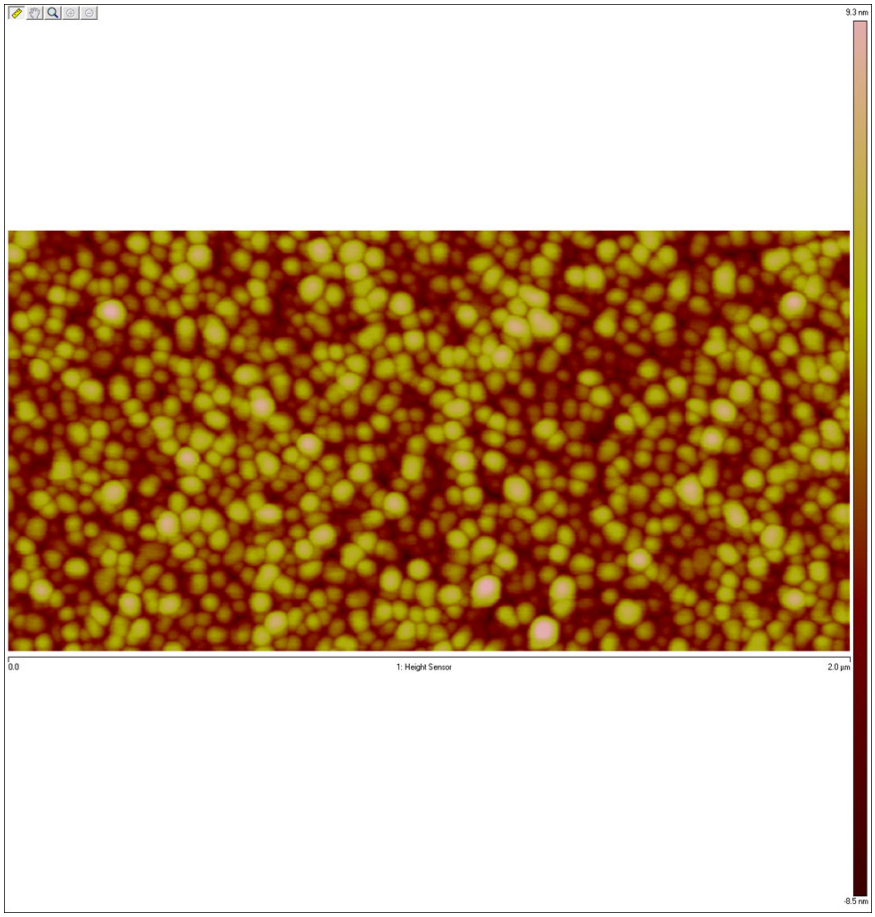

**Material: Cu** **Sample ID: AJA2-06**

Pressure: 7 mTorr Time: 500 sec Thickness: 2490 A Rate: 4.98 A/sec

Stress = 140.4 MPa (Tensile)

Roughness: Rq = 2.67 nm Ra = 2.16 nm Rmax = 19.6 nm

## AJA2-07 - Cu



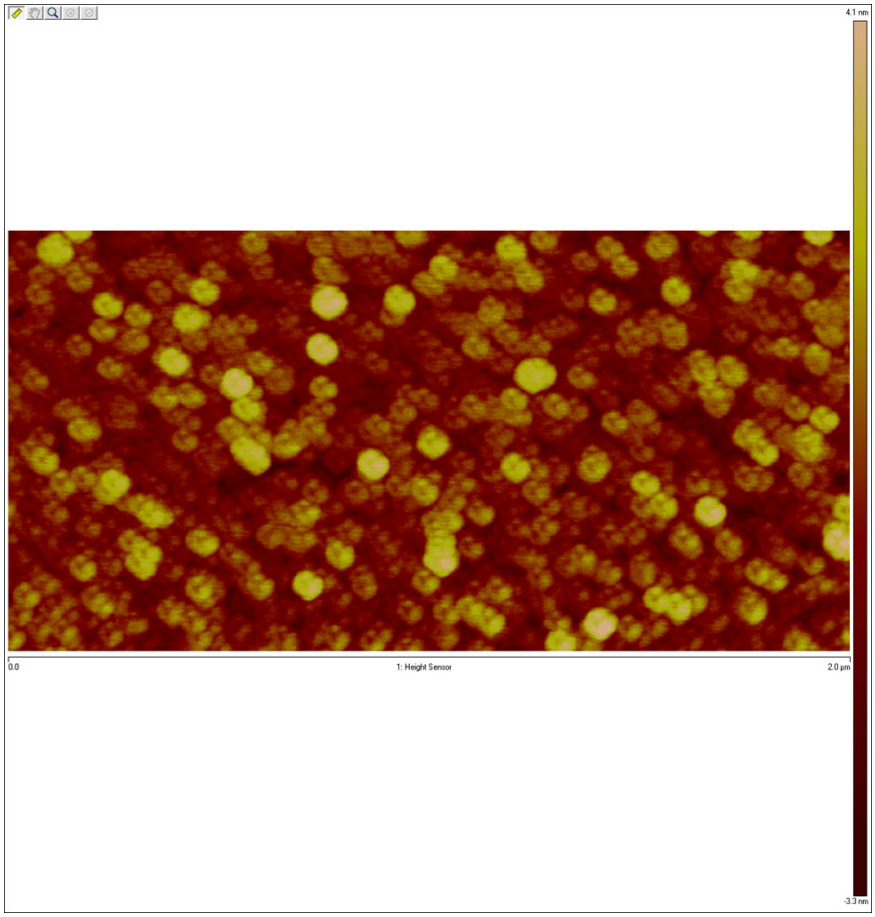

**Material: Cu** **Sample ID: AJA2-07**

Pressure: 20 mTorr Time: 500 sec Thickness: 1850 A Rate: 3.70 A/sec

Stress = 186.5 MPa (Tensile)

Roughness: Rq = 2.58 nm Ra = 2.07 nm Rmax = 19.5 nm

## AJA1-22 - MoSi2



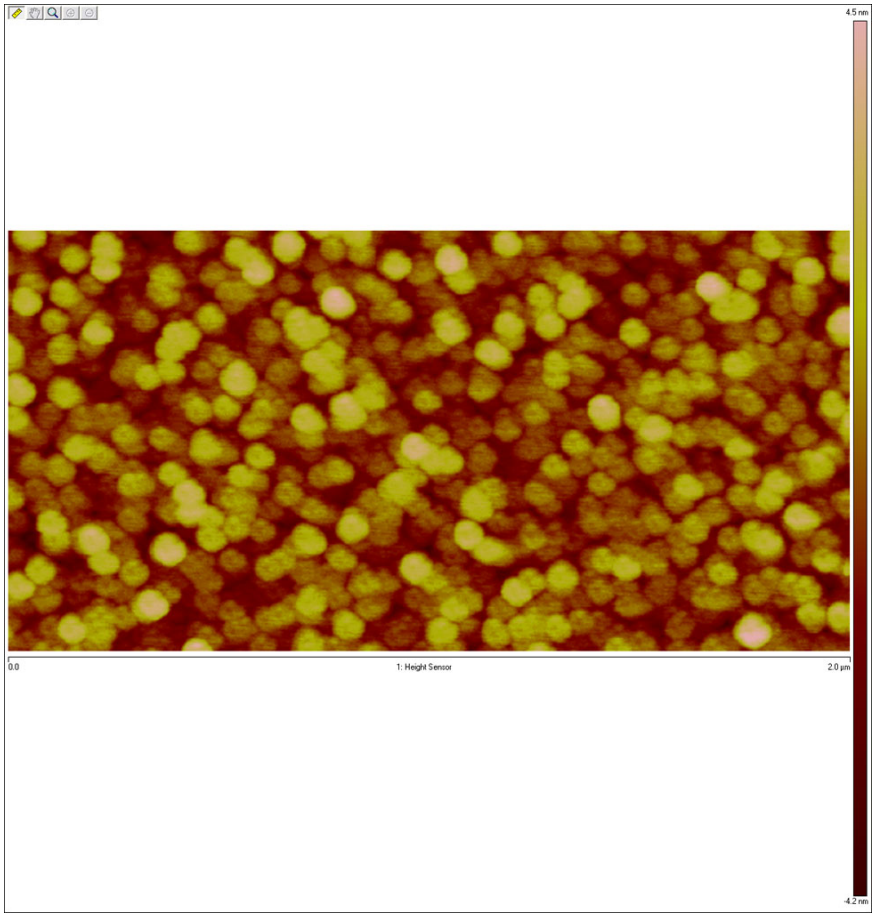

**Material: MoSi2** **Sample ID: AJA1-22**

Pressure: 3 mTorr Time: 2000 sec Thickness: 4840 A Rate: 2.42 A/sec

Stress = 420.5 MPa (Tensile)

Roughness: Rq = 1.04 nm Ra = 0.822 nm Rmax = 8.37 nm

## AJA1-23 - MoSi2



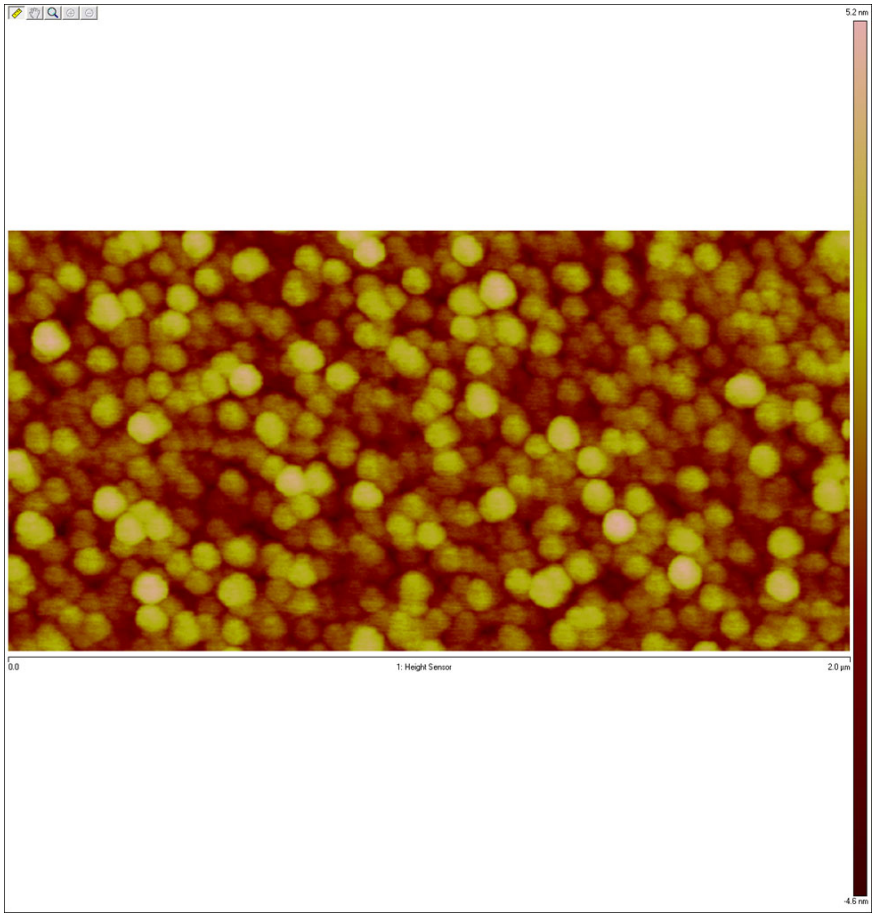

**Material: MoSi2** **Sample ID: AJA1-23**

Pressure: 7 mTorr Time: 1500 sec Thickness: 3690 A Rate: 2.46 A/sec

Stress = -334.9 MPa (Compressive)

Roughness: Rq = 1.29 nm Ra = 1.04 nm Rmax = 9.13 nm

## AJA1-24 - MoSi2



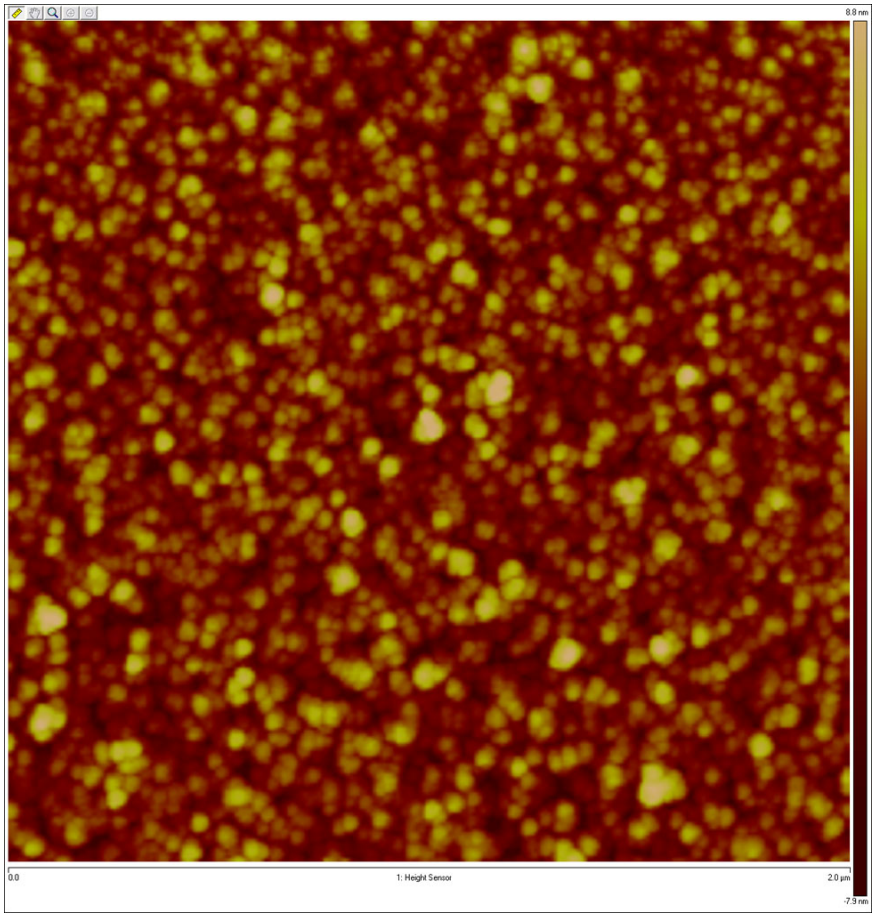

**Material: MoSi2** **Sample ID: AJA1-24**

Pressure: 20 mTorr Time: 1500 sec Thickness: 3160 A Rate: 2.11 A/sec

Stress = -122.1 MPa (Compressive)

Roughness: Rq = 1.41 nm Ra = 1.12 nm Rmax = 10 nm

## AJA1-10 - SiO2



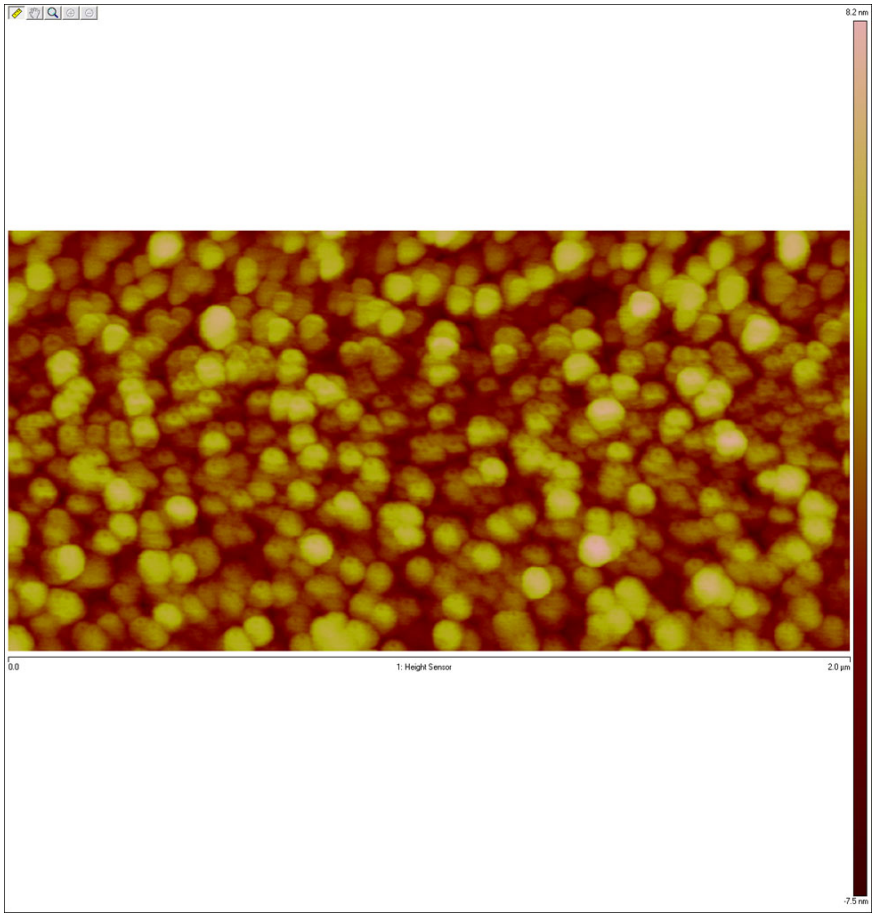

**Material: SiO2** **Sample ID: AJA1-10**

Pressure: 3 mTorr Time: 3600 sec Thickness: 2700 A Rate: 0.75 A/sec

Stress = -84.2 MPa (Compressive)

Roughness: Rq = 2.4 nm Ra = 1.91 nm Rmax = 18 nm

# AJA1-25 - SiO2



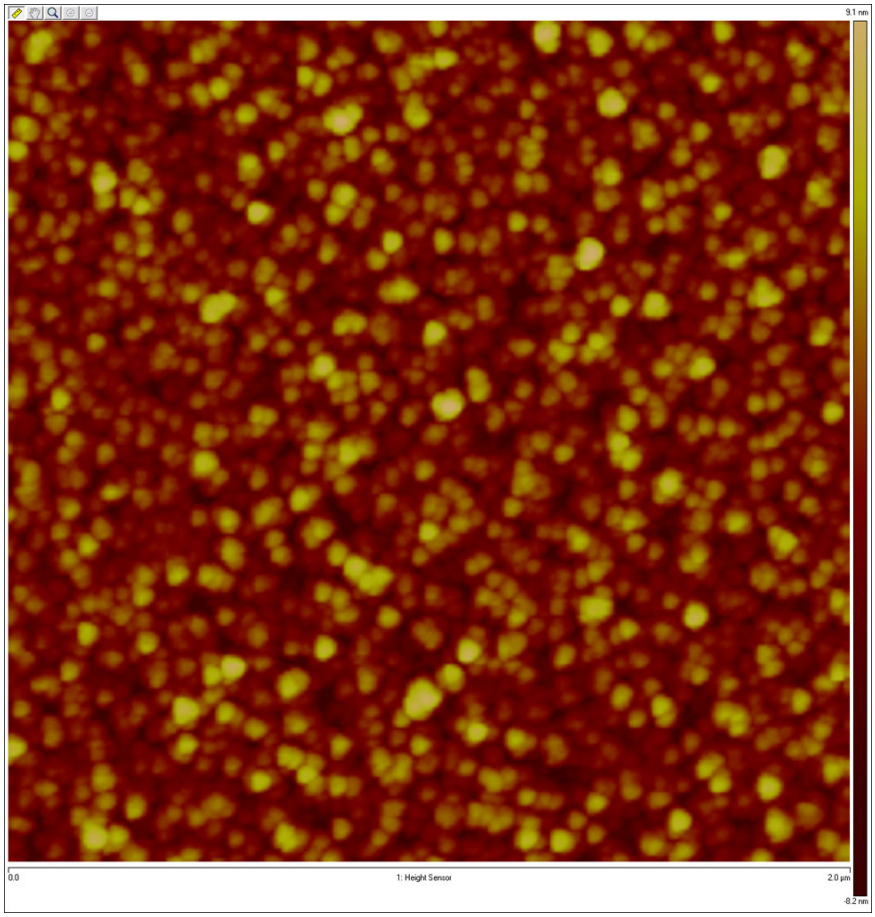

**Material: SiO2** **Sample ID: AJA1-25**

Pressure: 3 mTorr Time: 3600 sec Thickness: 3080 A Rate: 0.86 A/sec

Stress = -73 MPa (Compressive)

Roughness: Rq = 2.28 nm Ra = 1.82 nm Rmax = 16.7 nm

## AJA1-11 - SiO2



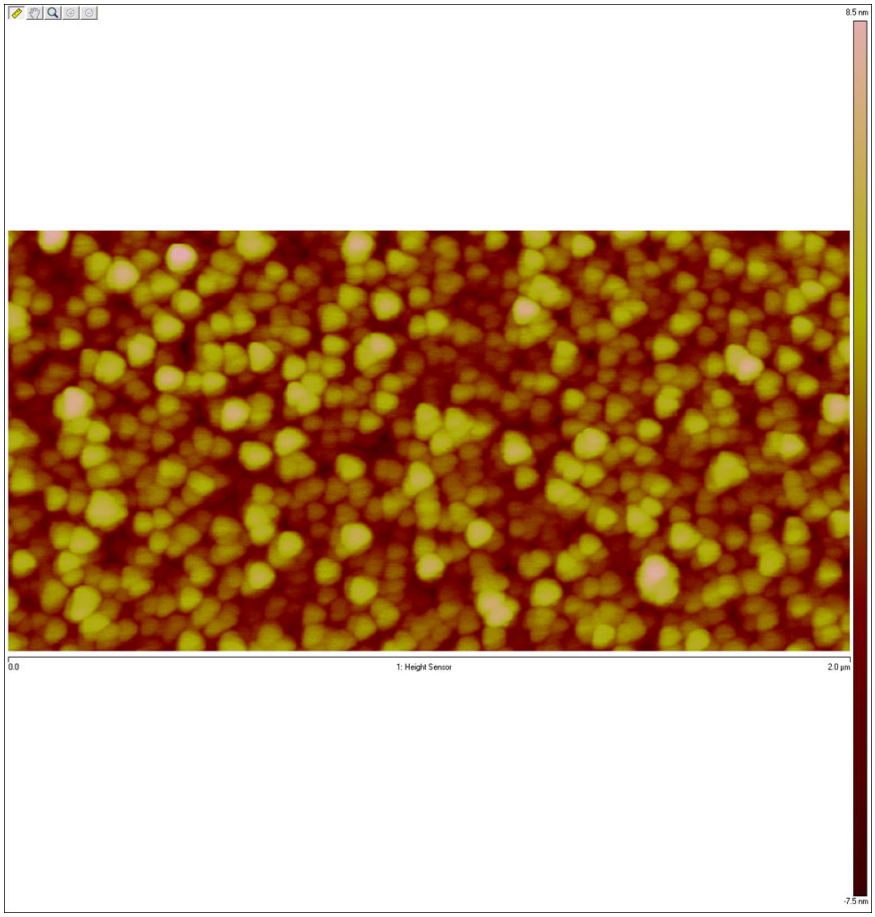

**Material: SiO2** **Sample ID: AJA1-11**

Pressure: 7 mTorr Time: 4500 sec Thickness: 2630 A Rate: 0.58 A/sec

Stress = -45.5 MPa (Compressive)

Roughness: Rq = 2.47 nm Ra = 1.97 nm Rmax = 18.7 nm

## AJA2-01 - SiO2



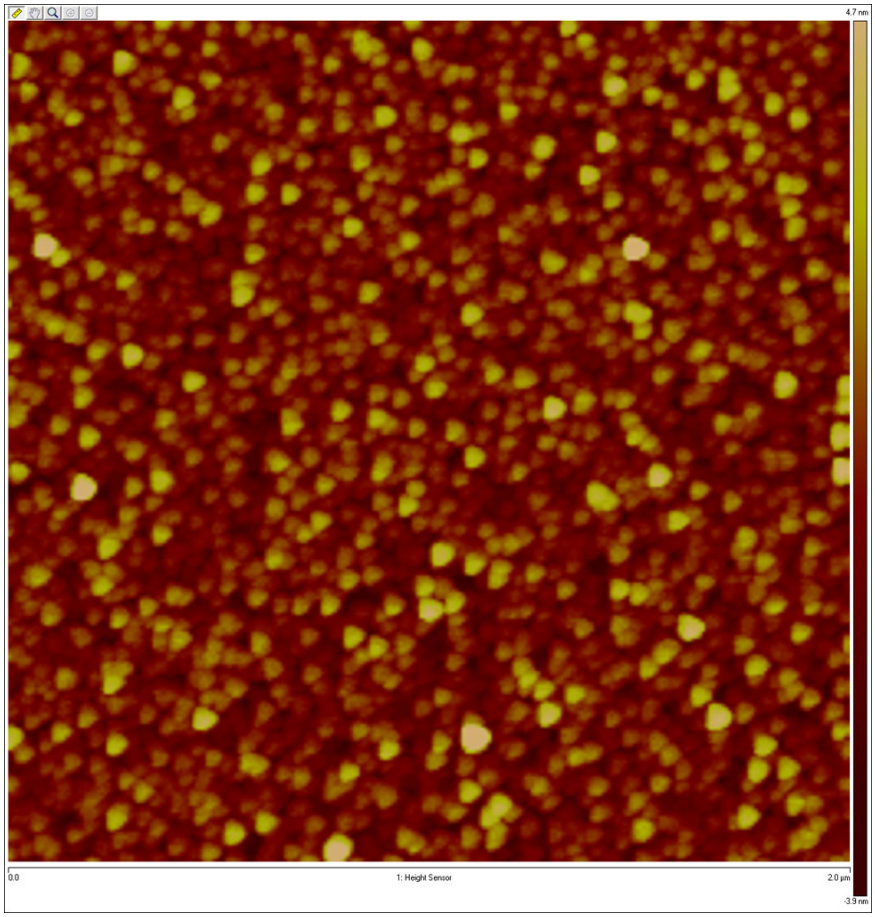

**Material: SiO2** **Sample ID: AJA2-01**

Pressure: 7 mTorr Time: 4000 sec Thickness: 2680 A Rate: 0.67 A/sec

Stress = -33.7 MPa (Compressive)

Roughness: Rq = 2.28 nm Ra = 1.81 nm Rmax = 17.5 nm

## AJA1-12 - SiO2



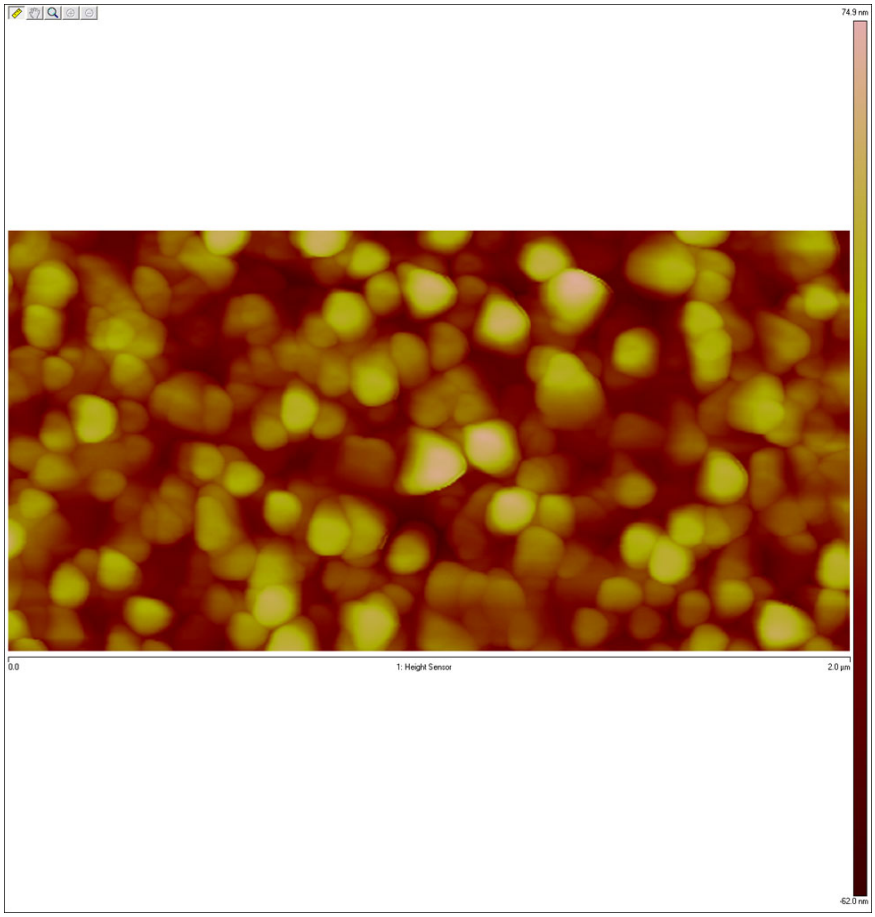

**Material: SiO2** **Sample ID: AJA1-12**

Pressure: 20 mTorr Time: 4500 sec Thickness: 1140 A Rate: 0.25 A/sec

Stress = -178 MPa (Compressive)

Roughness: Rq = 1.22 nm Ra = 0.961 nm Rmax = 10.8 nm

## AJA2-02 - Ti



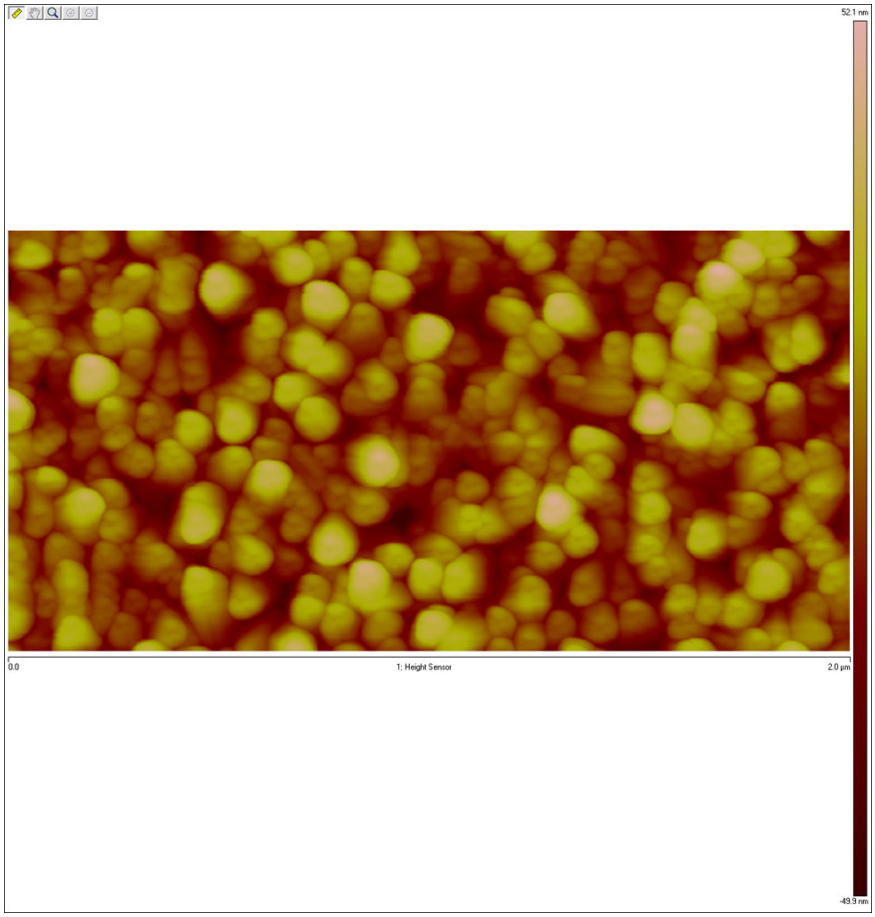

**Material: Ti** **Sample ID: AJA2-02**

Pressure: 3 mTorr Time: 1500 sec Thickness: 2510 A Rate: 1.67 A/sec

Stress = -15.2 MPa (Compressive)

Roughness: Rq = 19.4 nm Ra = 15.3 nm Rmax = 124 nm

## AJA2-03 - Ti



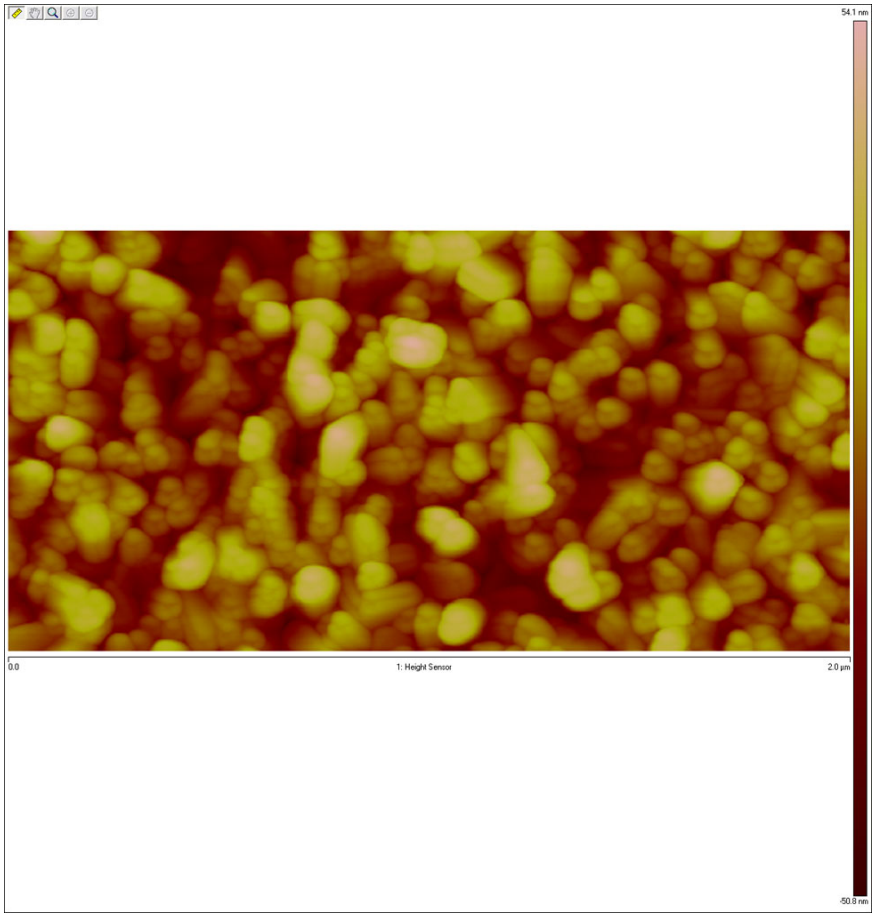

**Material: Ti** **Sample ID: AJA2-03**

Pressure: 7 mTorr Time: 1750 sec Thickness: 2620 A Rate: 1.50 A/sec

Stress = 74.5 MPa (Tensile)

Roughness: Rq = 14.3 nm Ra = 11.3 nm Rmax = 106 nm

# AJA2-04 - Ti



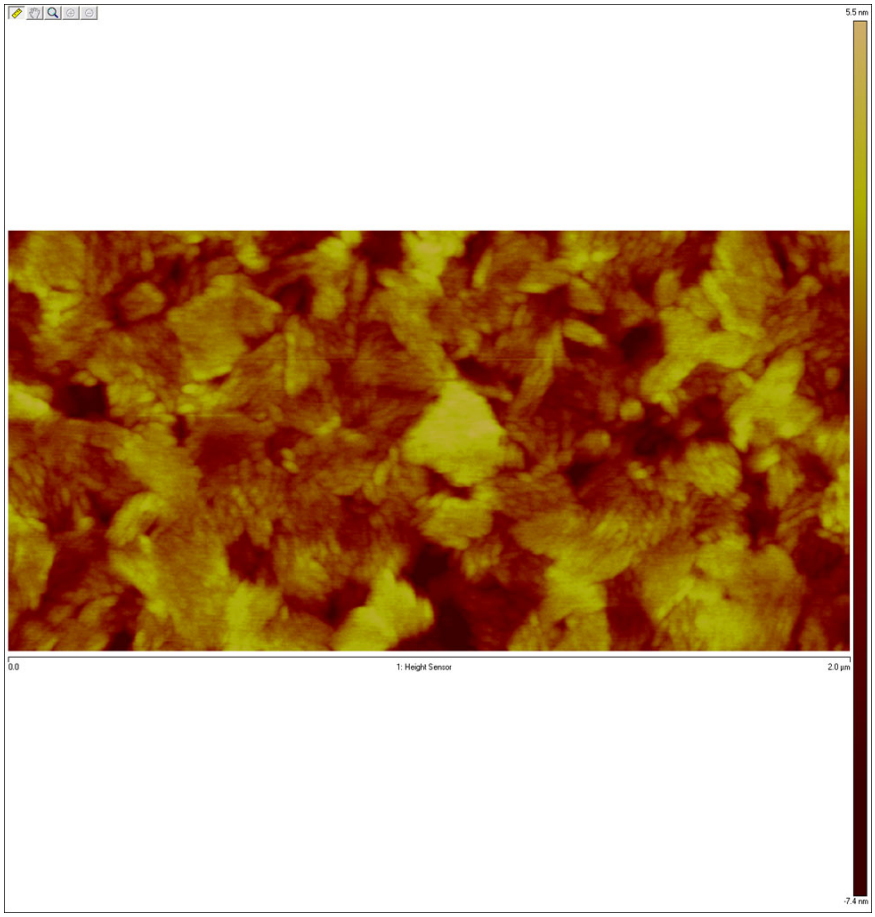

**Material: Ti** **Sample ID: AJA2-04**

Pressure: 20 mTorr Time: 3600 sec Thickness: 3130 A Rate: 0.87 A/sec

Stress = 68.4 MPa (Tensile)

Roughness: Rq = 15.1 nm Ra = 12 nm Rmax = 103 nm

## AJA2-11 - W



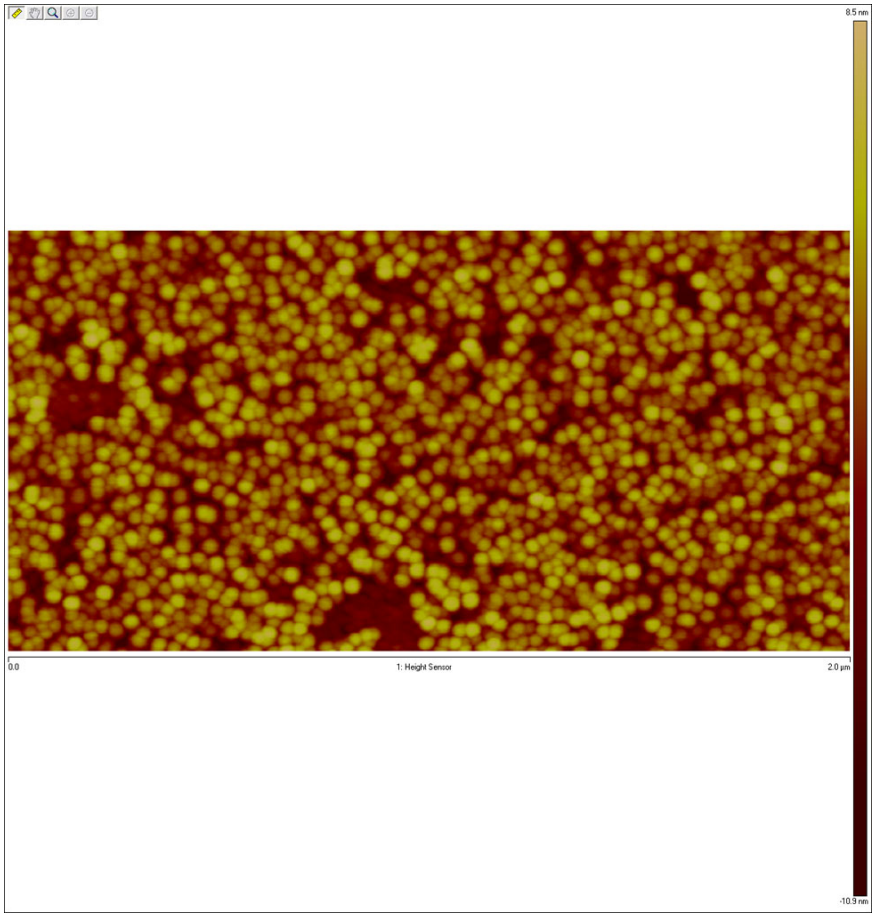

**Material: W** **Sample ID: AJA2-11**

Pressure: 3 mTorr Time: 1000 sec Thickness: 2190 A Rate: 2.19 A/sec

Stress = -2830 MPa (Compressive)

Roughness: Rq = 1.71 nm Ra = 1.32 nm Rmax = 13 nm

## AJA2-12 - W



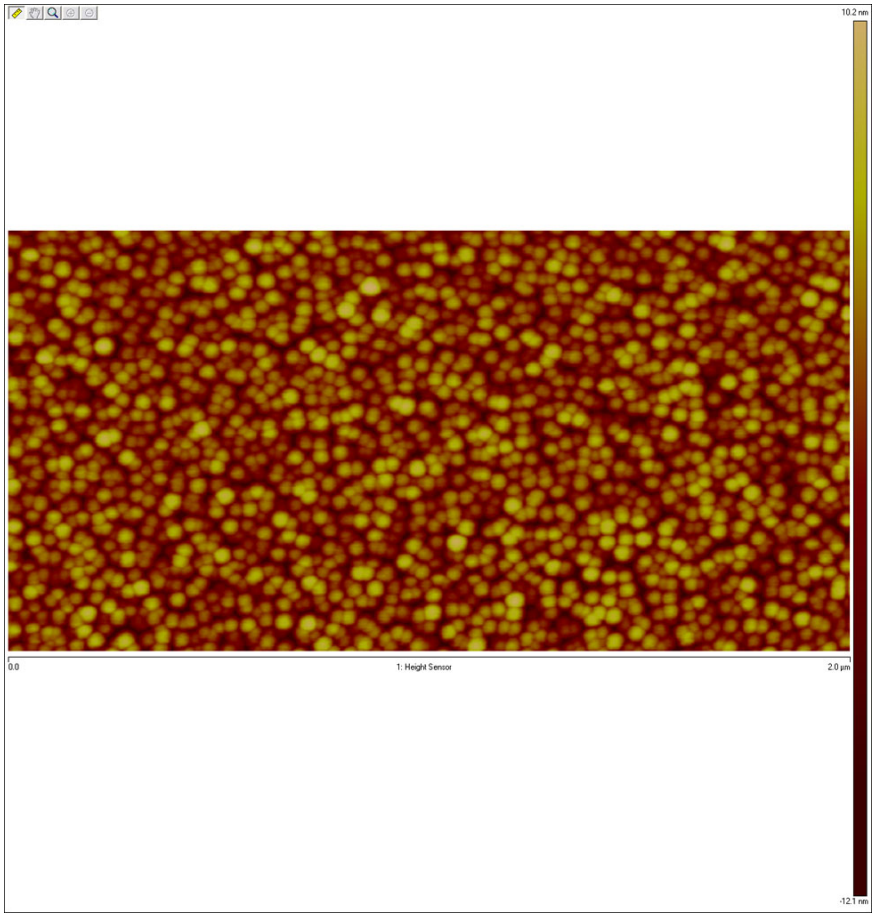

**Material: W** **Sample ID: AJA2-12**

Pressure: 7 mTorr Time: 1000 sec Thickness: 2390 A Rate: 2.39 A/sec

Stress = 1759 MPa (Tensile)

Roughness: Rq = 2.84 nm Ra = 2.25 nm Rmax = 22.5 nm

## AJA2-13 - W




**Material: W** **Sample ID: AJA2-13**

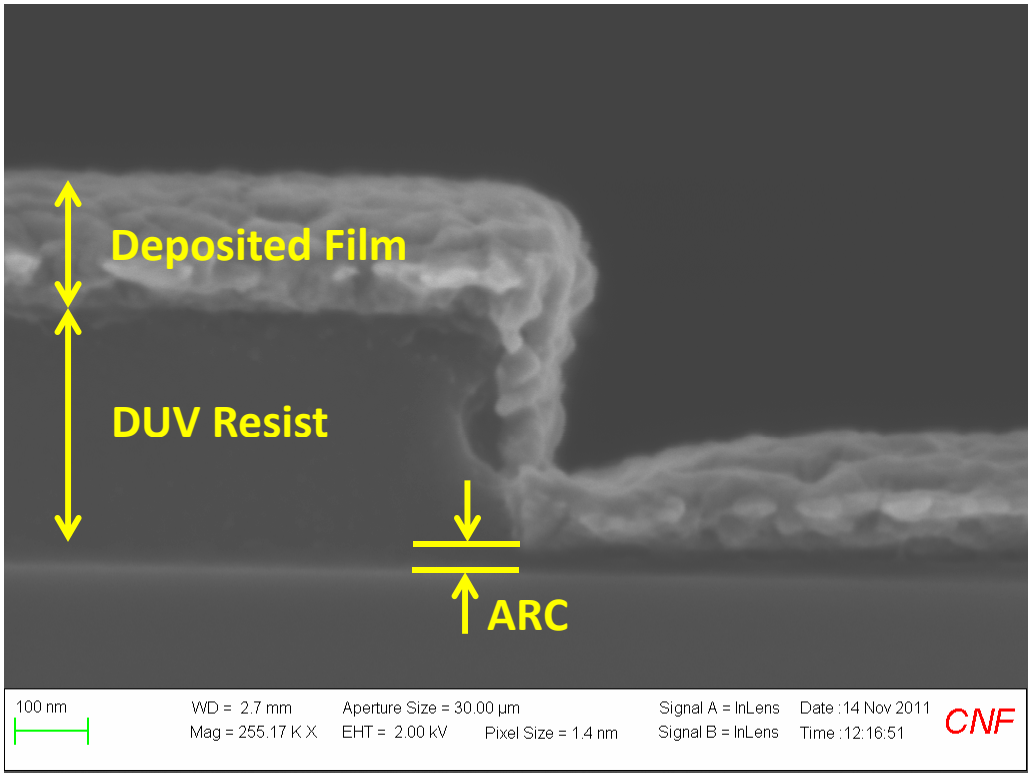
Pressure: 20 mTorr Time: 1000 sec Thickness: 2990 A Rate: 2.99 A/sec

Stress = -295 MPa (Compressive)

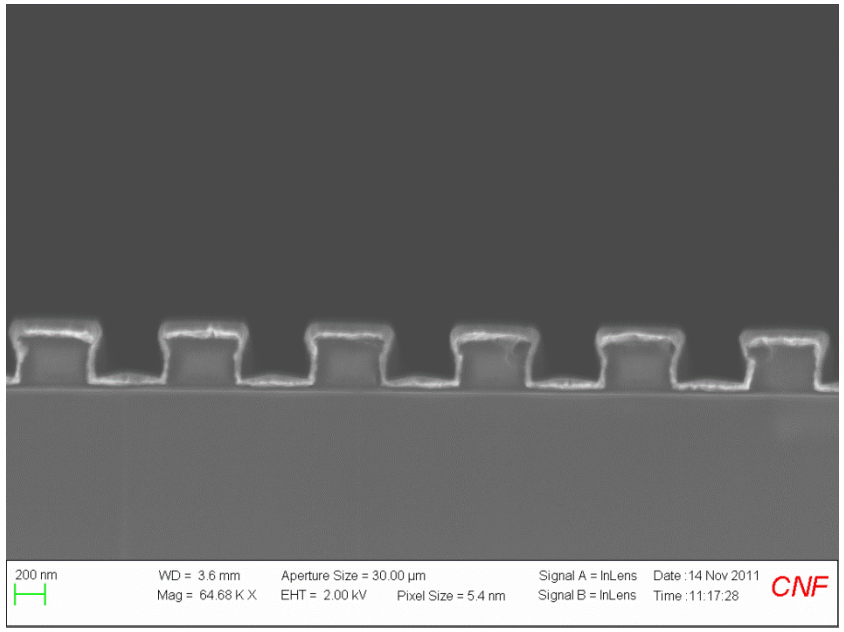
Roughness: Rq = 3.19 nm Ra = 2.53 nm Rmax = 26.7 nm

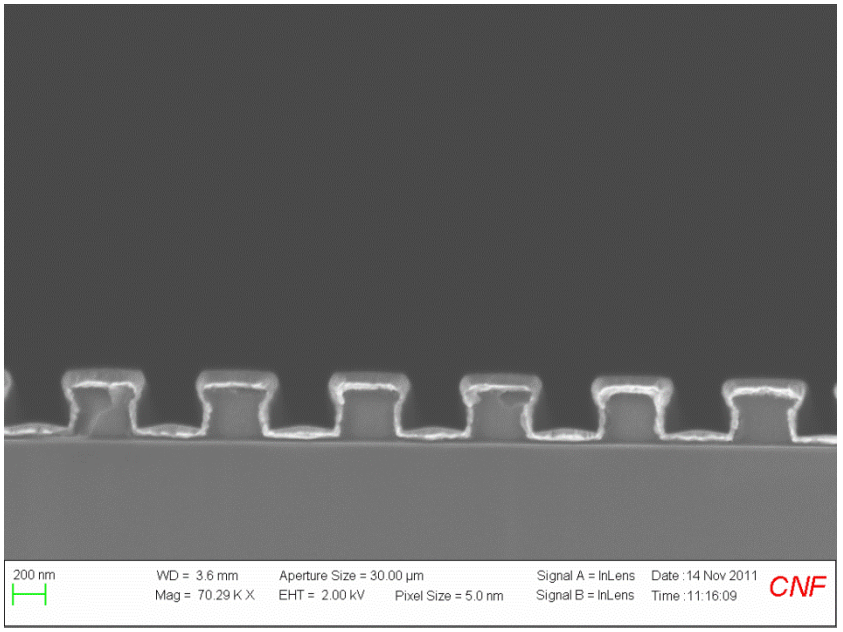
# AJA Step Coverage Process Data: SEM Analysis

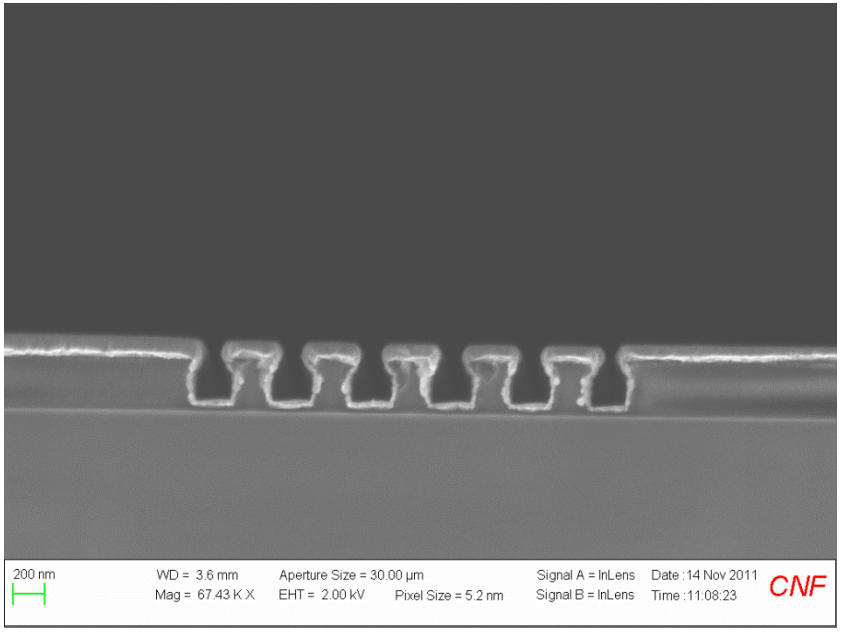
**Process Conditions**: Si wafers were spun with an anti-reflective coating AR3 (ARC), then DUV resist UV210-3 that was subsequently exposed and developed. Resist templates with ARC residing within the developed regions were used for step coverage evaluation. Following film deposition, wafers were cleaved and cross-sectional scanning electron microscopy was used to evaluate step coverage of various film stacks.

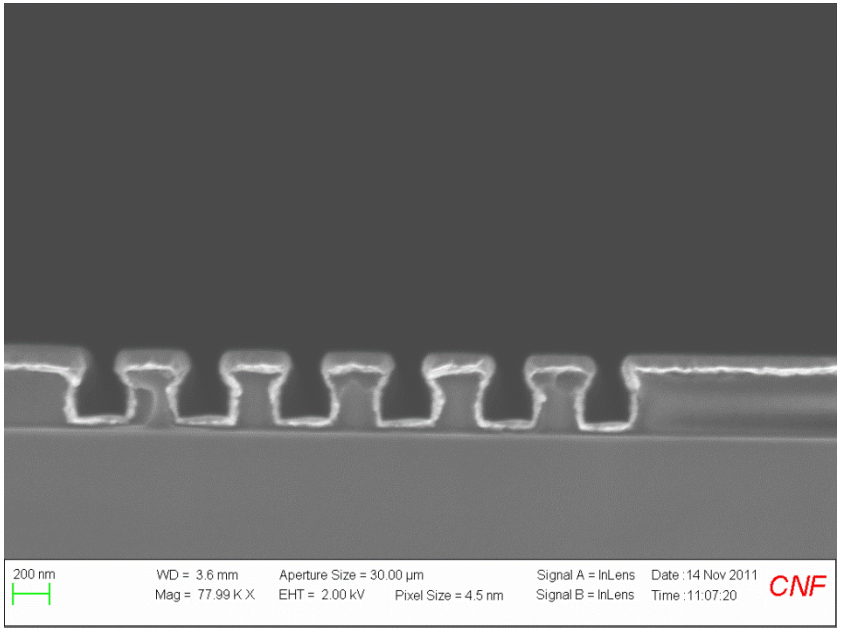


# **S01:** Adhesion Ti 60sec,  Cu 180sec

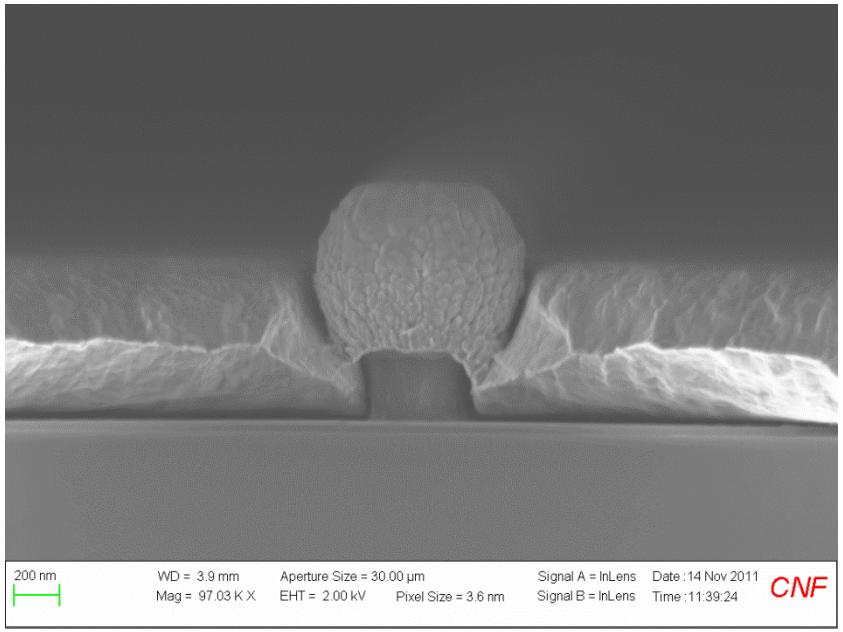


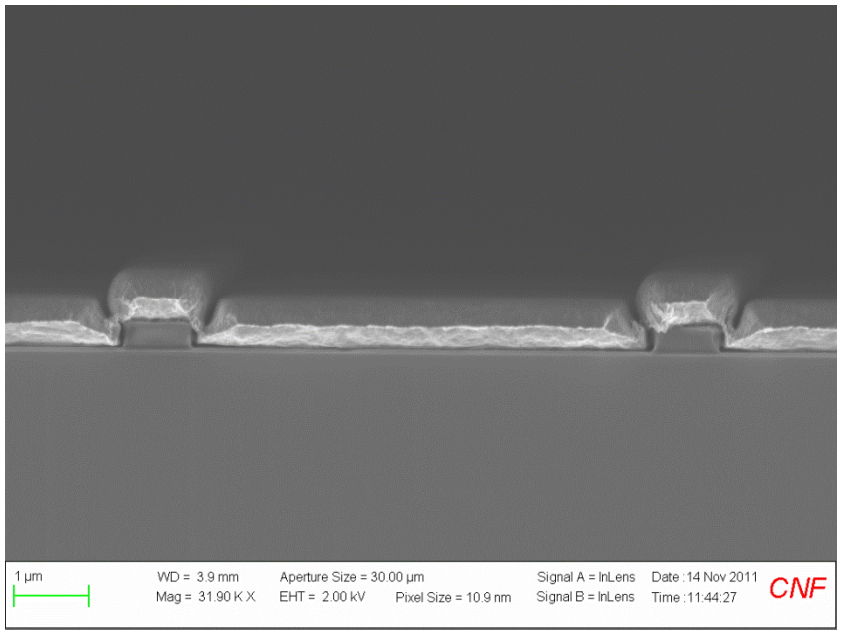



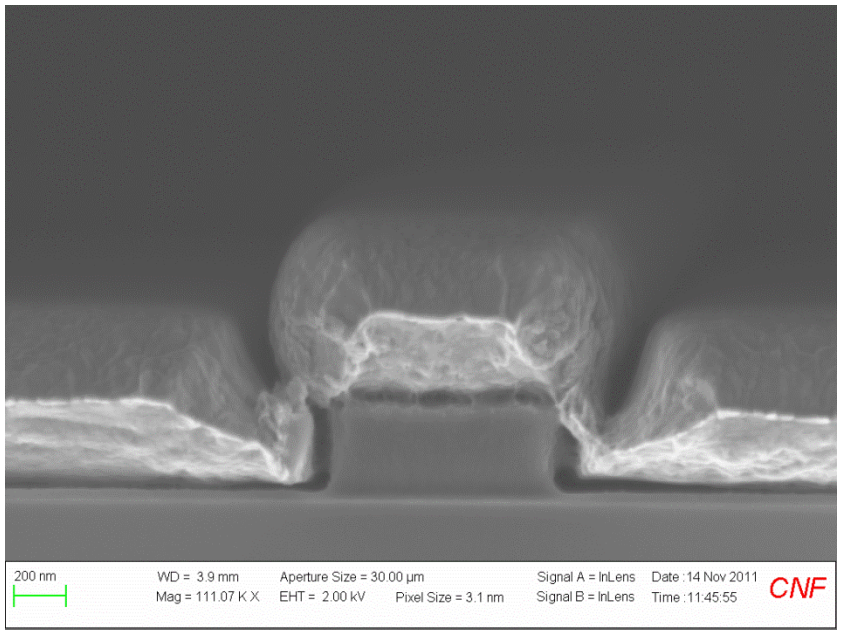



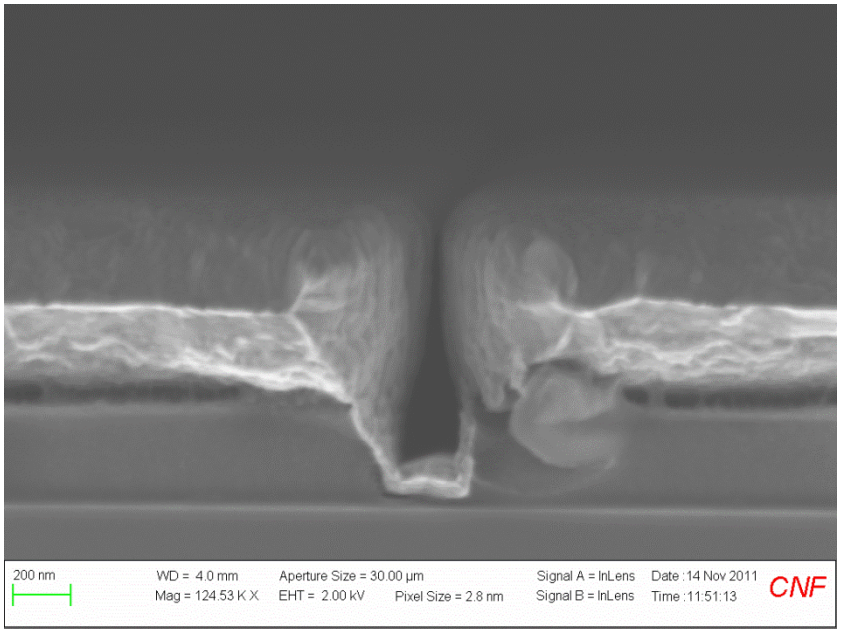



# **S02:** Adhesion Ti 60sec,  Cu 1000sec

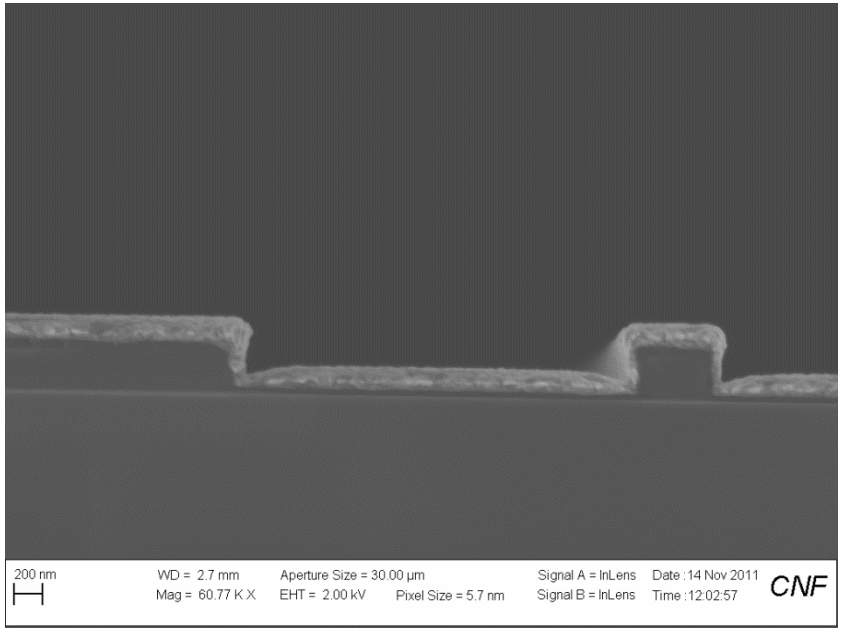


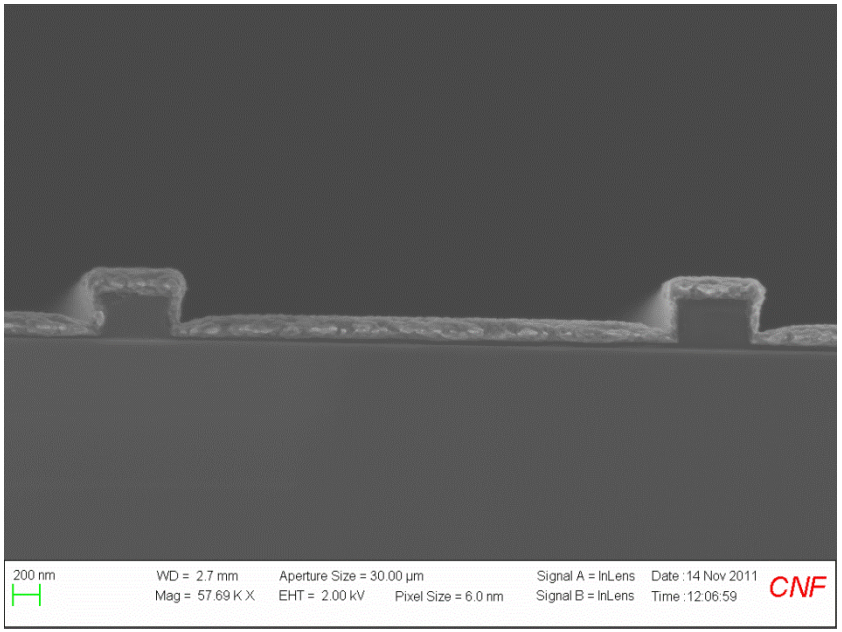



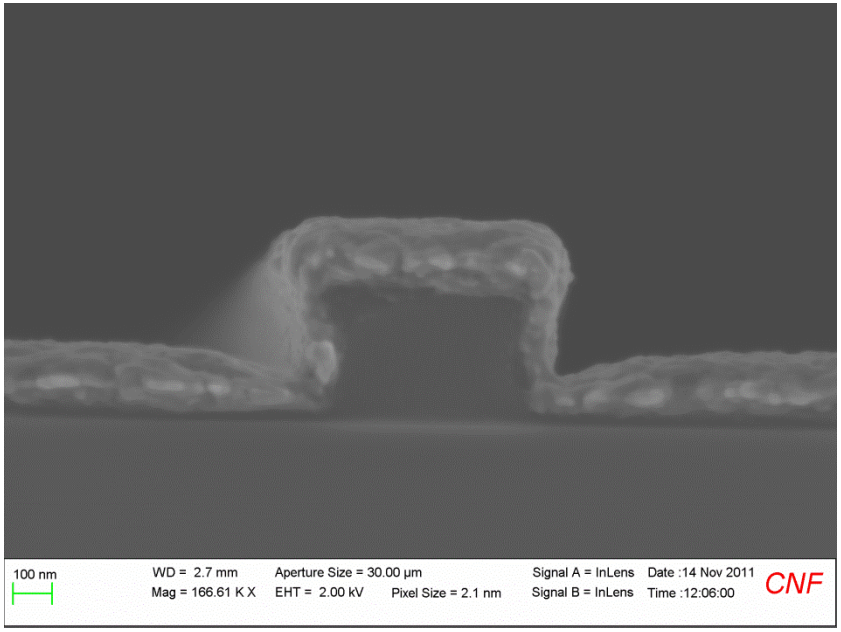



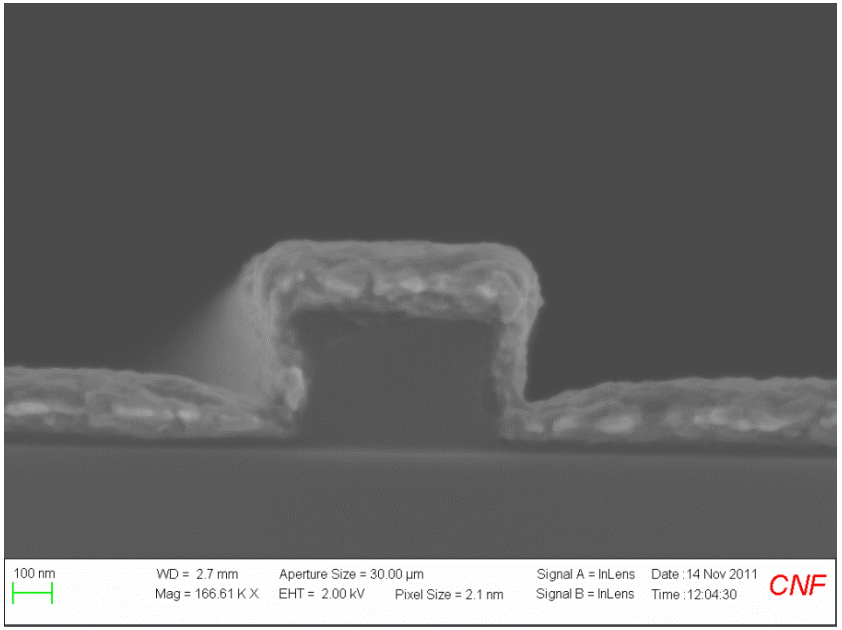



# **S03:** AlCuSi 1000sec

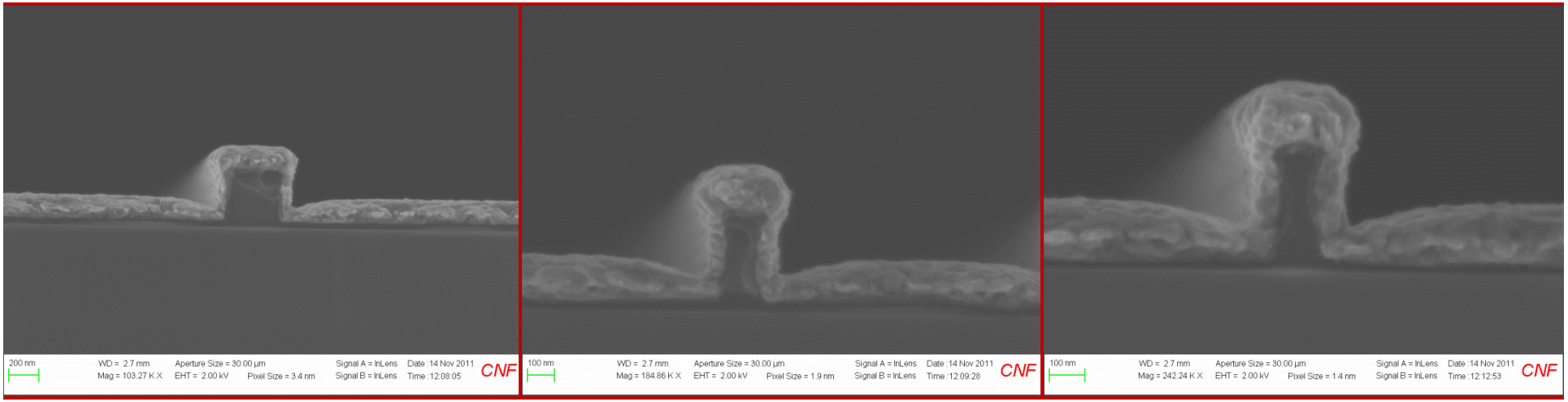


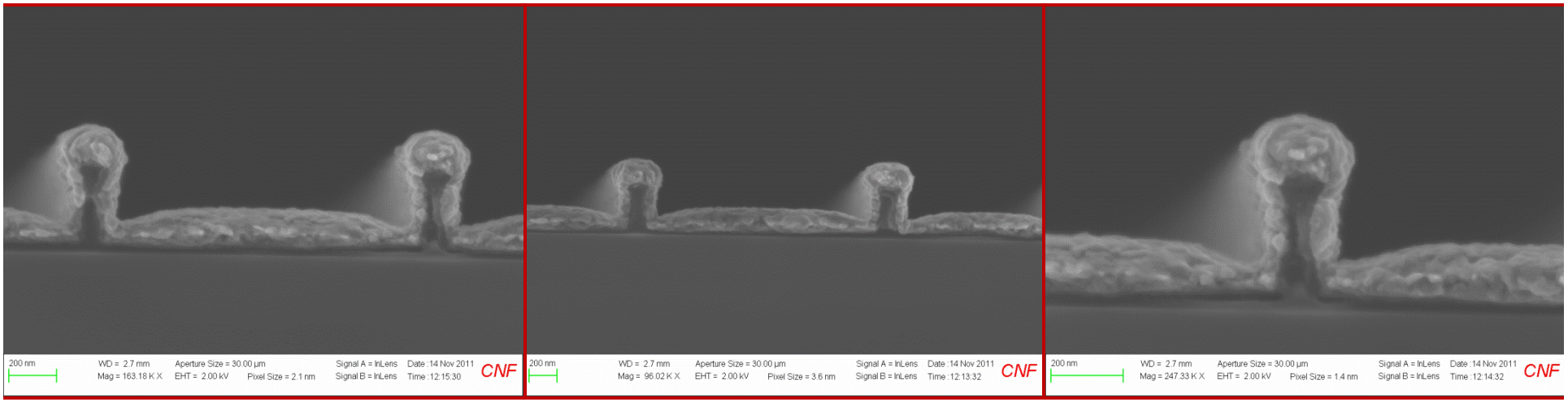



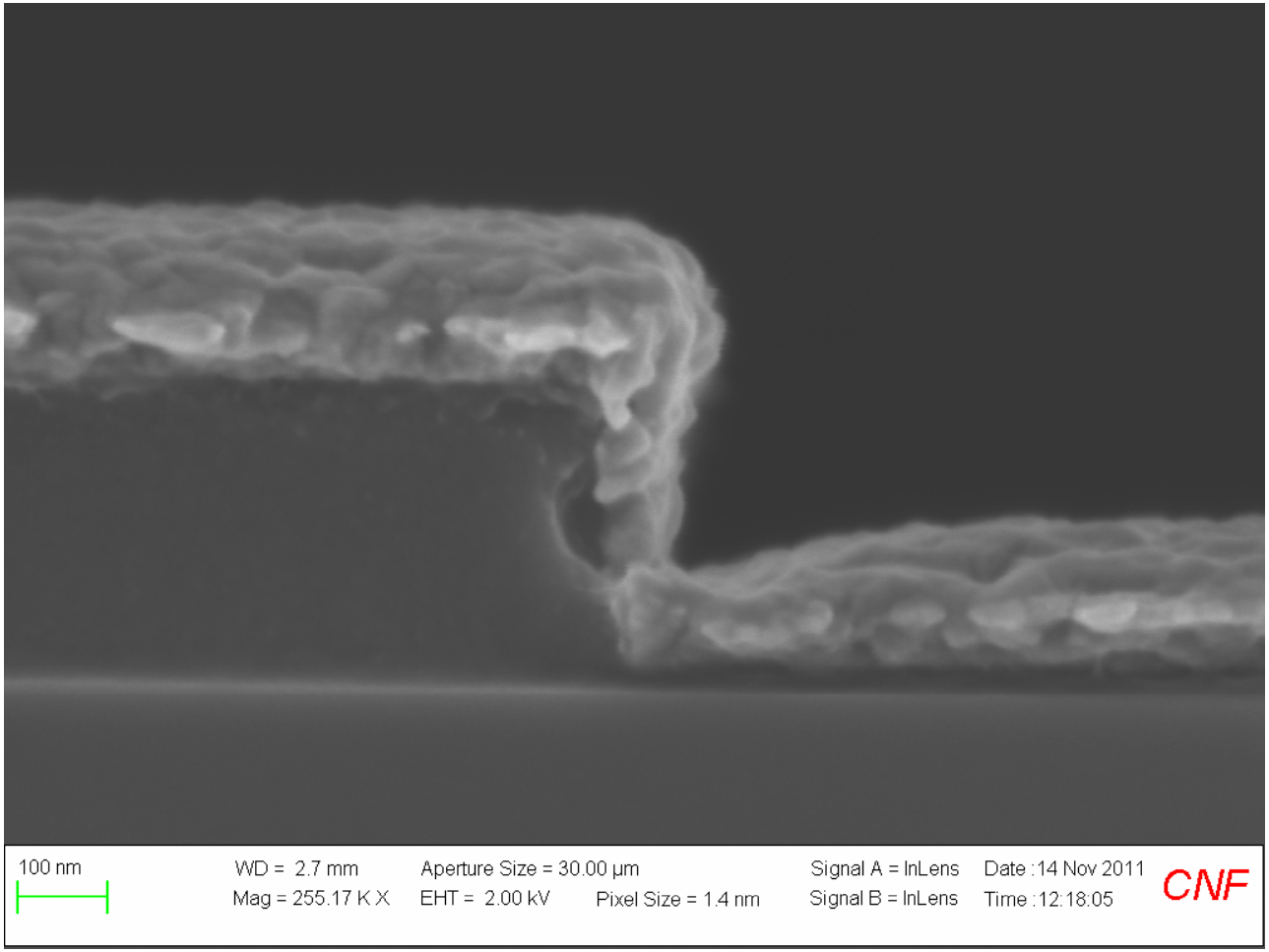



# **S03:** AlCuSi 1000sec

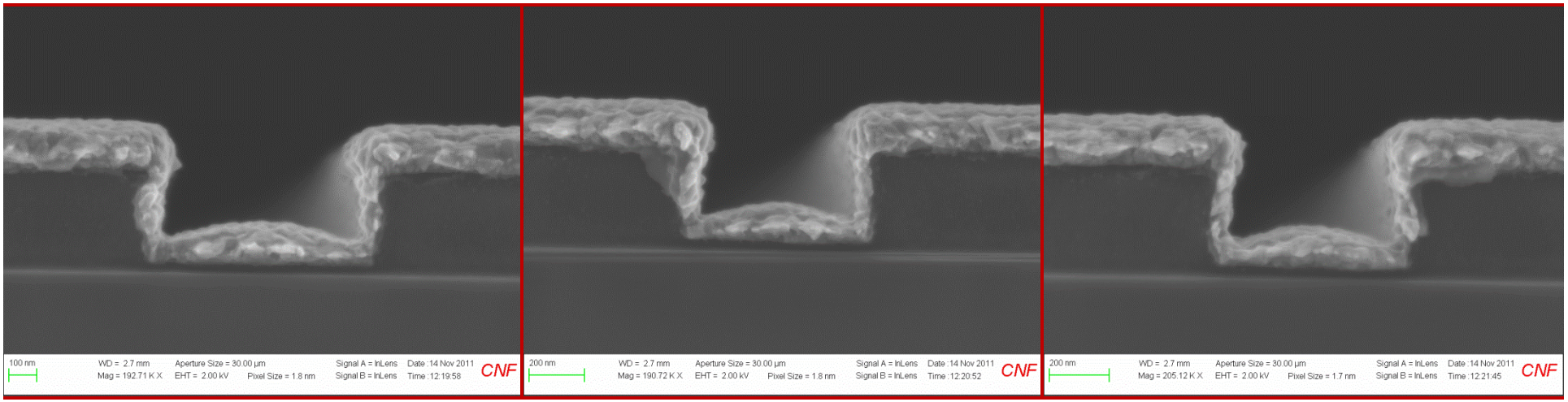


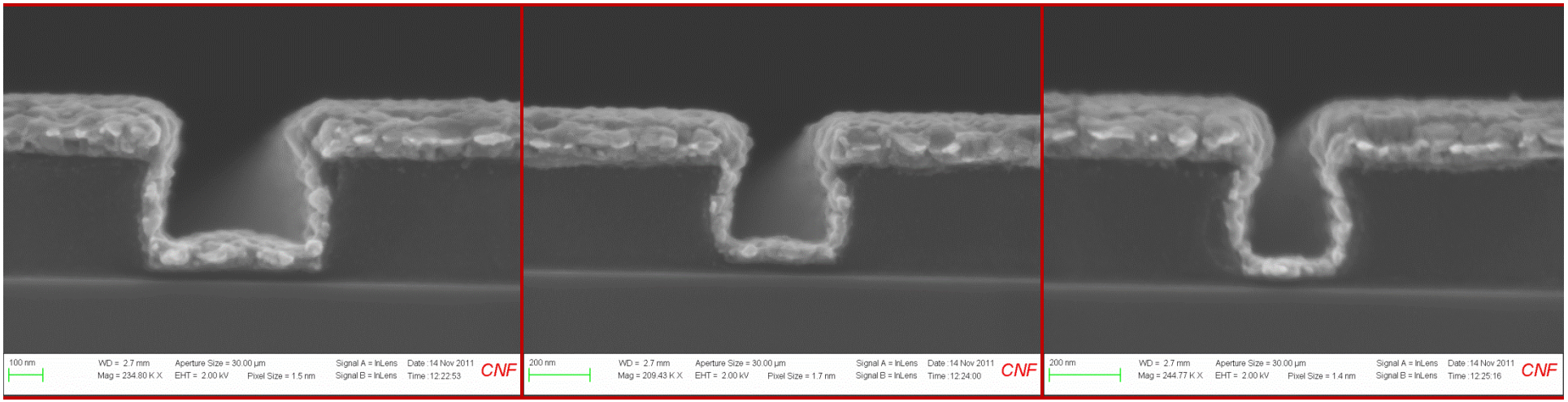



# **S03:** AlCuSi 1000sec

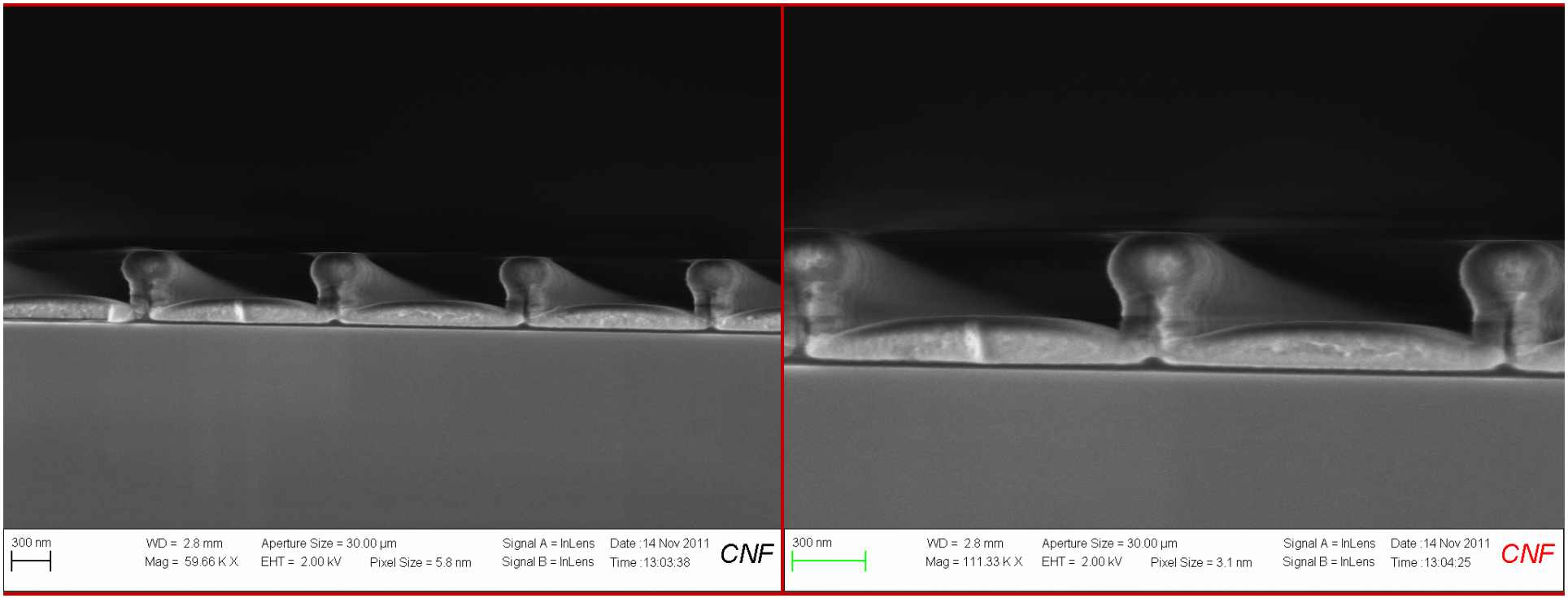


# **S03:** AlCuSi 1000sec



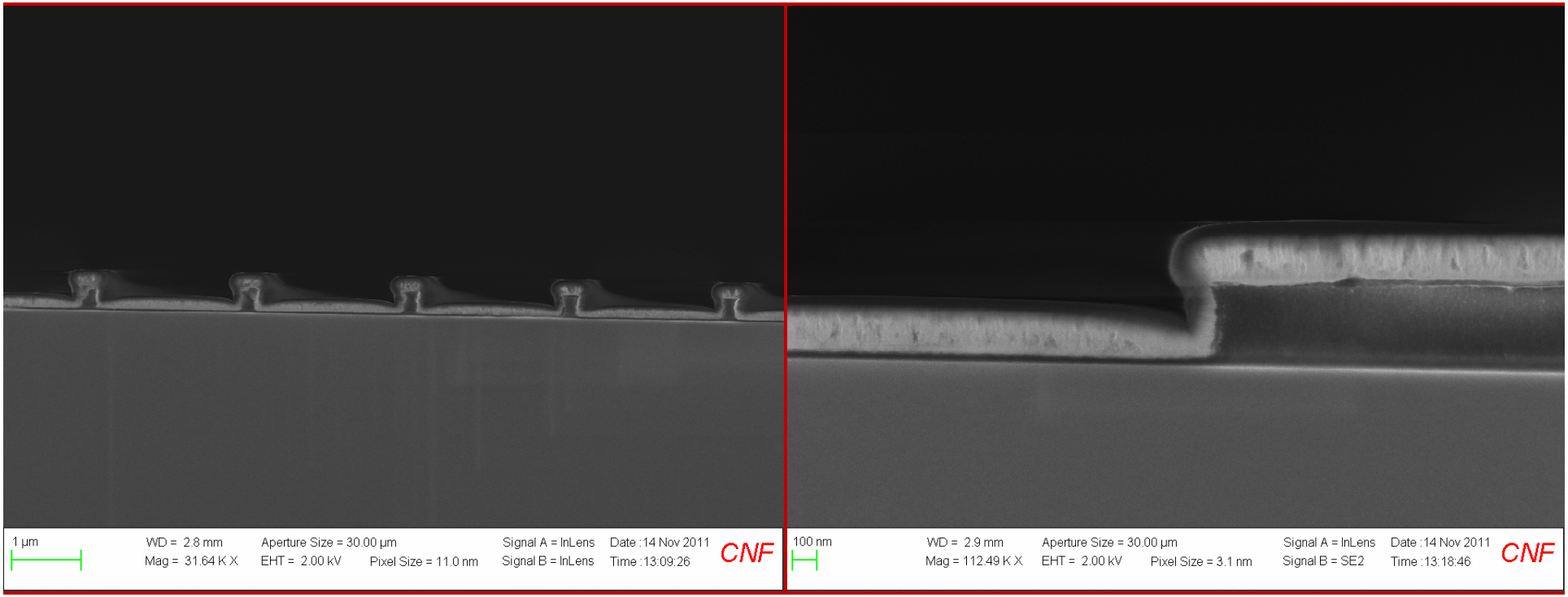



# **S04:** $SiO_2$ 1800sec




Sub-100nm ridges

# **S04:** $SiO_2$ 1800sec



# **S04:** $SiO_2$ 1800sec