APPENDIX A

Error analysis

A1. Standard Deviation

$$(\Delta S) = \left(\frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N(N-1)} \right)^{1/2}$$

where $\bar{x}$, x_i and N are mean data, data and number of data respectively.

A2. Standard Error

Consider S as a function of certain variable x, y, ….,

where, S = f (x, y, ……),

$$\left(\frac{\Delta S}{S}\right) = \left[\left(\frac{\Delta x}{x}\right)^2 + \left(\frac{\Delta y}{y}\right)^2 + ... \right]^{1/2},$$

where x, y,…. is various variable.

A3. Error of film thickness, Δd

The film thickness, d

$$d = \left(\frac{m\lambda}{2n(\lambda)} \right)$$

The Δd is, $\left(\frac{\Delta d}{d}\right)^2 = \left(\frac{\Delta \lambda}{\lambda}\right)^2 + \left(\frac{\Delta n(\lambda)}{n(\lambda)}\right)^2$,

where, $\Delta\lambda$ = 2 nm, $\Delta n(\lambda)$ = 0.01 , Δd = 5 nm.

A4. Error of optical band gap, ΔE_g

The optical band gap is determined by,

$$(\alpha h\nu) = B\,(h\nu - Eg)^2,$$

where, $Eg = \left(\frac{c}{m}\right)$,

c and m are the intercept and slope for the plot of (αhν) versus E.

The ΔE_g is, $\left(\frac{\Delta E_g}{E_g}\right)^2 = \left(\frac{\Delta c}{c}\right)^2 + \left(\frac{\Delta m}{m}\right)^2$

$$\Delta E_g = 0.05 \text{ eV}$$

The error of c and m is obtained using regression in data analysis program in Microsoft Excel.

A5. Error of Hydrogen Content, ΔC_H

Error in the hydrogen content was obtained from the FTIR analysis. The equation for integrated intensity, I and area under the curve, S is given. The hydrogen concentration, C_H or H%,

$$C_H = \frac{N_H}{N_C} \text{ x } 100\%$$

$$\left(\frac{\Delta C_H}{C_H}\right)^2 = \left(\frac{\Delta N_H}{N_H}\right)^2 + \left(\frac{\Delta N_C}{N_C}\right)^2$$

$\Delta C_H = 5\%$, where, $\Delta N_H = 0.01$, $\Delta N_C = 0.01 \text{ x } 10^{23}$

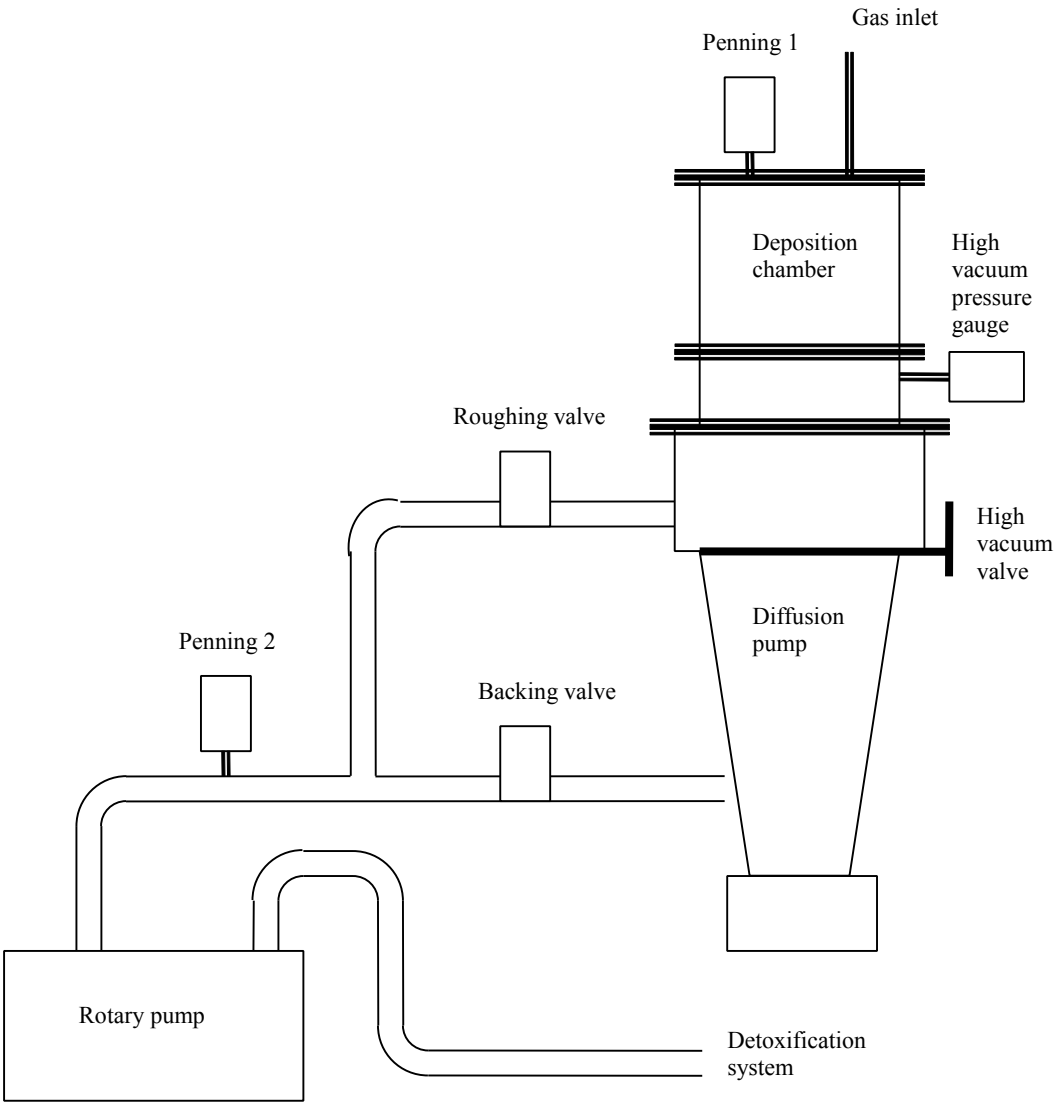
APPENDIX B

Deposition System

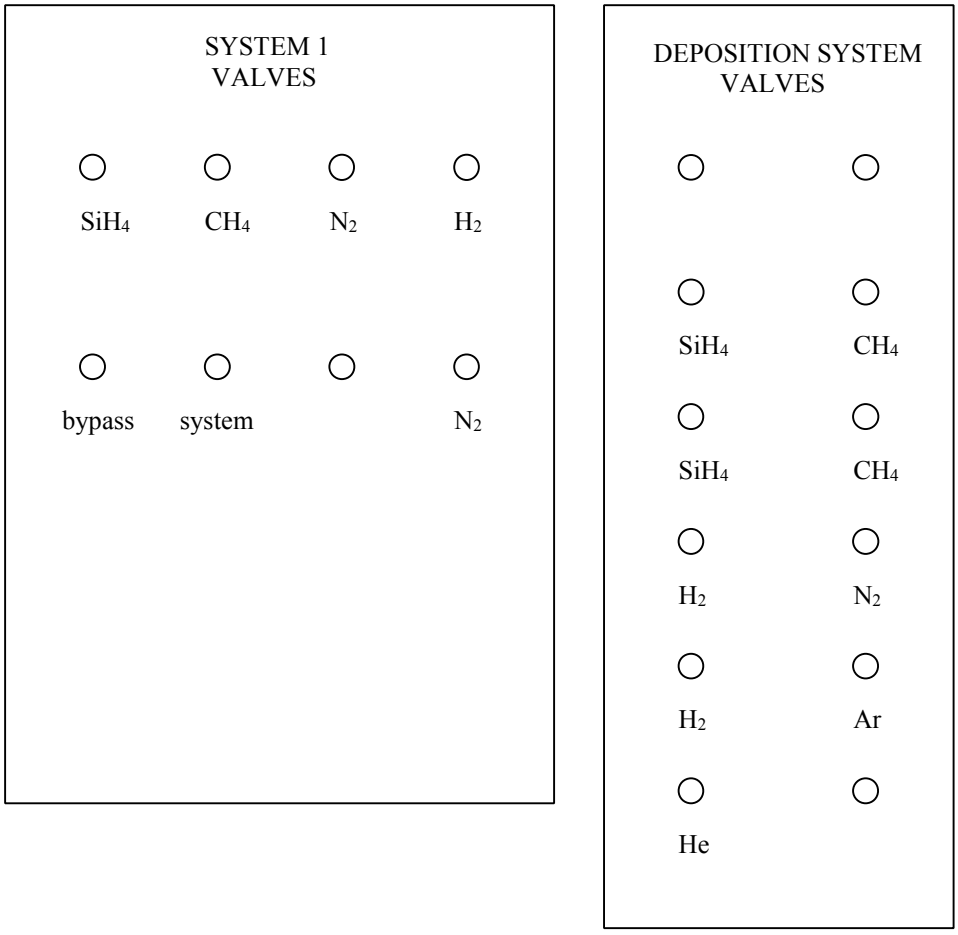
B1. Deposition procedure.

VACUUMING THE DEPOSITION CHAMBER

1. CLOSE all valves.
2. ON Rotary Pump, Penning and Pirani pressure meter.
3. OPEN roughing valve, wait until the chamber pressure or Penning meter, P_e is ~ 1 x 10^{-3} mbar.
4. OPEN backing valve, wait until P_e is ~ 1 x 10^{-3} mbar.
5. Checking the gas lines:
   - CLOSE backing valve.
   - OPEN the gas lines involved to vacuum the gas lines.
   - Make sure P_e is ~ 1 x 10^{-3} mbar.
6. Flow water through the coil around the diffusion pump. Make sure there is water flowing at the end of the line. Switch on the fan.
7. OPEN backing valve.
8. ON diffusion pump, wait for about 15 minutes to heat.
9. CLOSE roughing valve.
10. OPEN high vacuum valve, wait until HV display at S1 is ~ 1 x 10^{-5} mbar.
11. ON the substrate heater, wait for the pre-set temperature.
12. Check the base pressure, CLOSE high vacuum valve.
13. OFF diffusion pump.
14. OPEN roughing valve. (backing valve is kept open, close only when diffusion pump has cooled down.)
15. ON OSK, check voltage (zero).
16. FLOW the deposition gas, pressure goes down, P_e ~ 1 x 10^{-1} mbar. Adjust the roughing valve to control the deposition pressure.
17. READY to deposit. ON power, deposition starts.


Gas inlet
Penning 1
Deposition chamber
High vacuum pressure gauge
Roughing valve
High vacuum valve
Diffusion pump
Penning 2
Backing valve
Rotary pump
Detoxification system

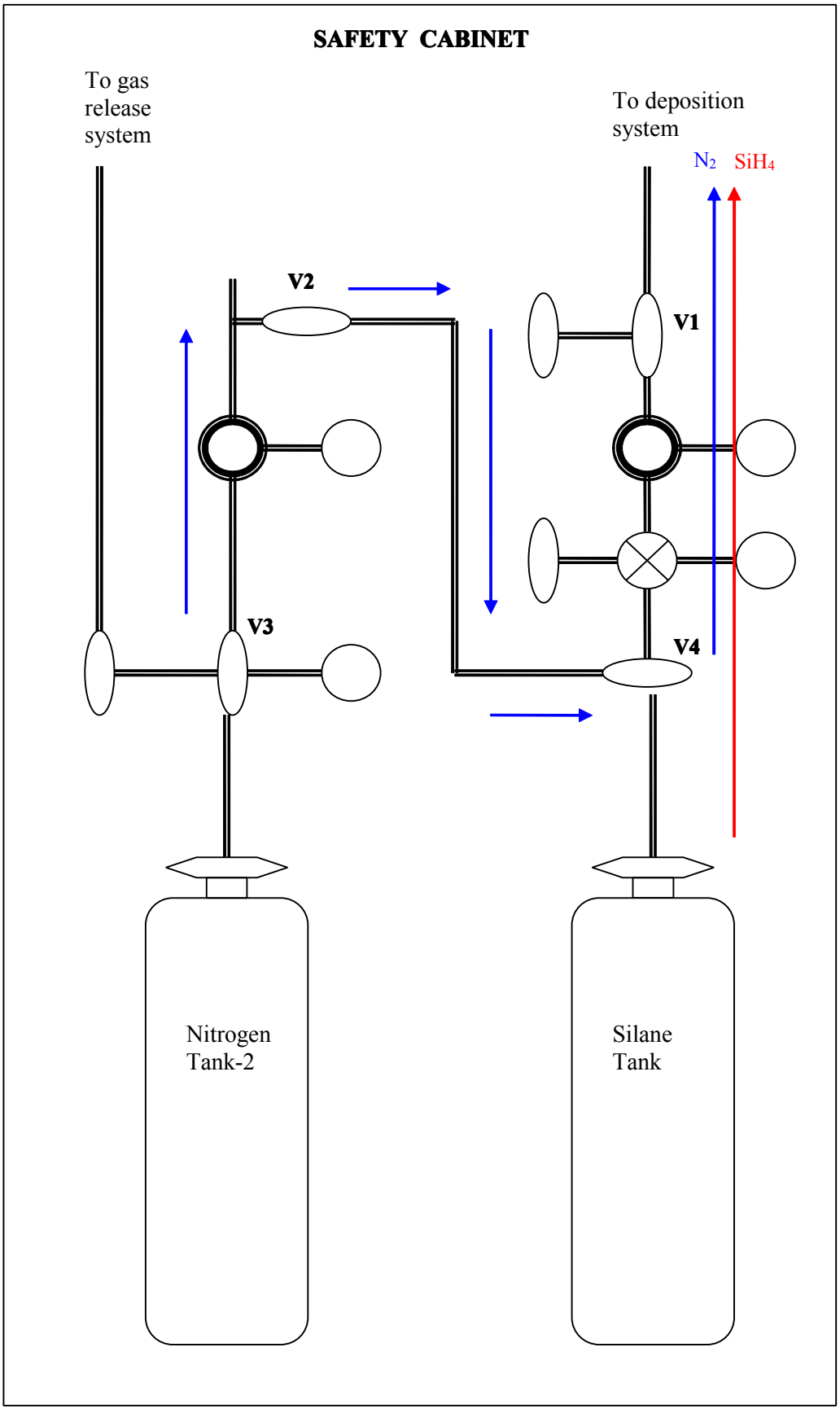
DEPOSITION USING SILANE GAS



1. Vacuuming the gas lines

1. Turn on the metering valve. Wait until pressure is 10^{-3}.
2. On the control panel of System-1:-
    1. Turn on the system valve. Wait until pressure is 10^{-3}.
    2. Turn on the SiH_4 valve. Wait until pressure is 10^{-3}.

3. On the control panel of Deposition System:-
    1. Turn on the SiH_4 valve. Wait until pressure is 10^{-3}.


SAFETY CABINET
To gas release system
To deposition system
N_2
SiH_4
V2
V1
V3
V4
Nitrogen Tank-2
Silane Tank

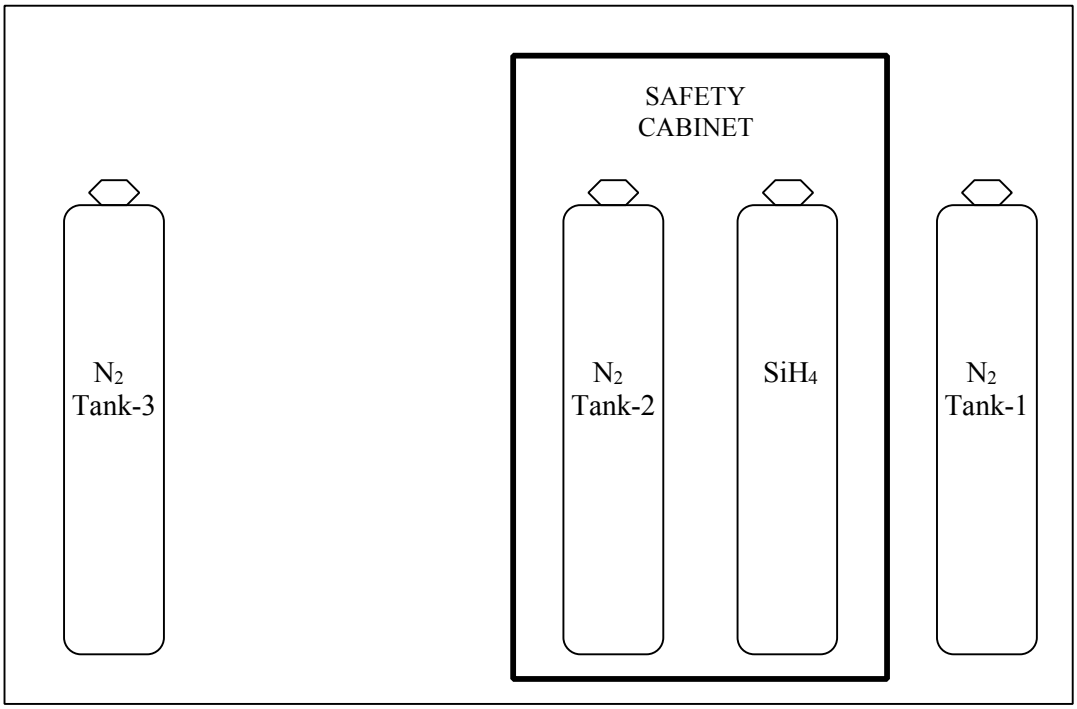
2. Purging with N_2 gas

1. Switch on the main switch.
2. Switch on the switch on the switch board, including the emergency button. Make sure the green light turns on.
3. Turn on the N_2 tank outside the cabinet (Nitrogen tank-1)
4. Turn on V1, V2 and V3.
5. Wait until pressure is 10^{-3}.

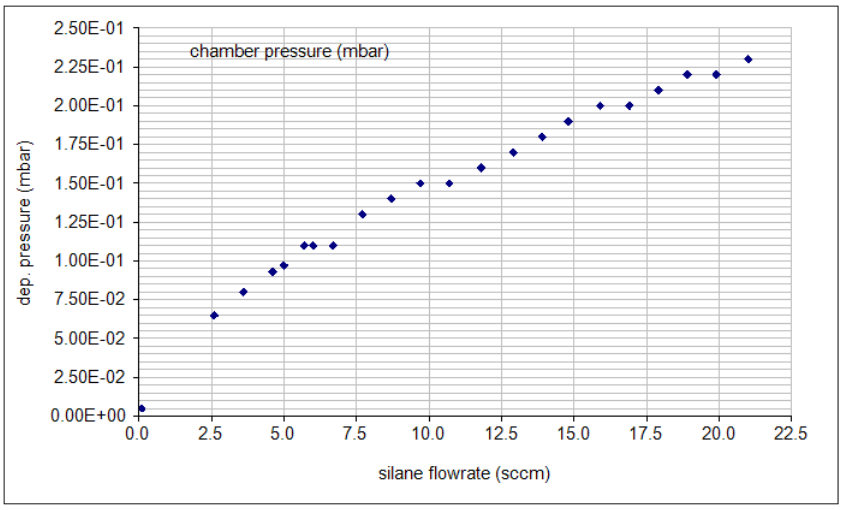
6. Turn off the metering valve.
7. Turn on(and off) the N_2 gas inside the cabinet (Nitrogen tank-2).
8. Turn on the metering valve slowly. Silane gas line is now being purged with nitrogen gas.
9. Wait until pressure is 10^{-3}.
10. Wait until the released N_2 gas is finished (indicated at the volume meter).

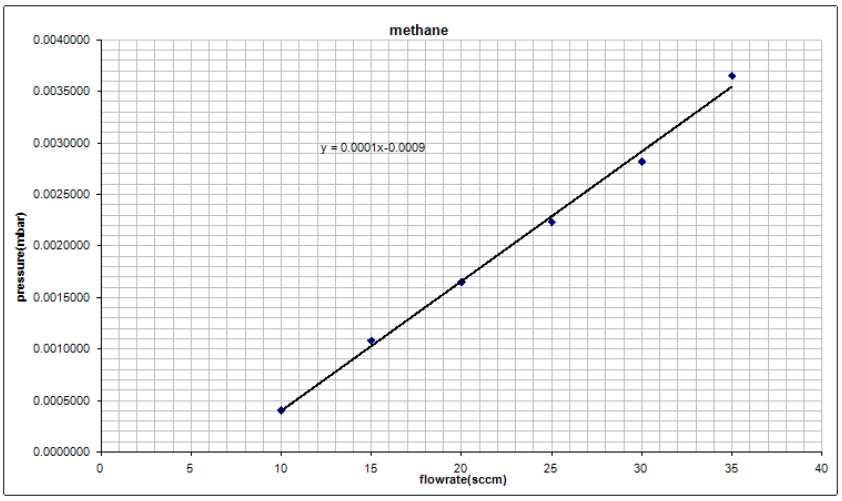
3. Flowing the SiH_4 gas into the deposition chamber.

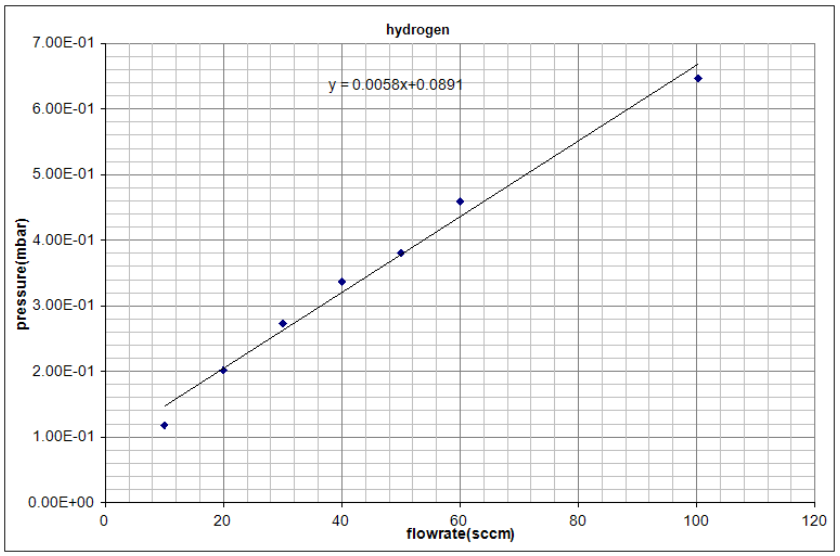
1. Close the backing valve.
2. Turn off the metering valve.
3. Turn on the N_2 gas for the deposition chamber (Nitrogen tank-3)
4. Turn on the N_2 valve at control panel of Deposition System.
5. Turn on the lower N_2 valve at control panel of System-1.
6. Turn on the by-pass valve at control panel of System-1.
7. Turn off V2 and V3.
8. Turn on V4.
9. Turn on(and off) the SiH_4 valve until the pressure meter at the tank is ~400 Psi. Now silane gas is in the line.
10. Turn on the metering valve until desired pressure is reached.
11. Switch on the current and voltage. DEPOSITION STARTS.



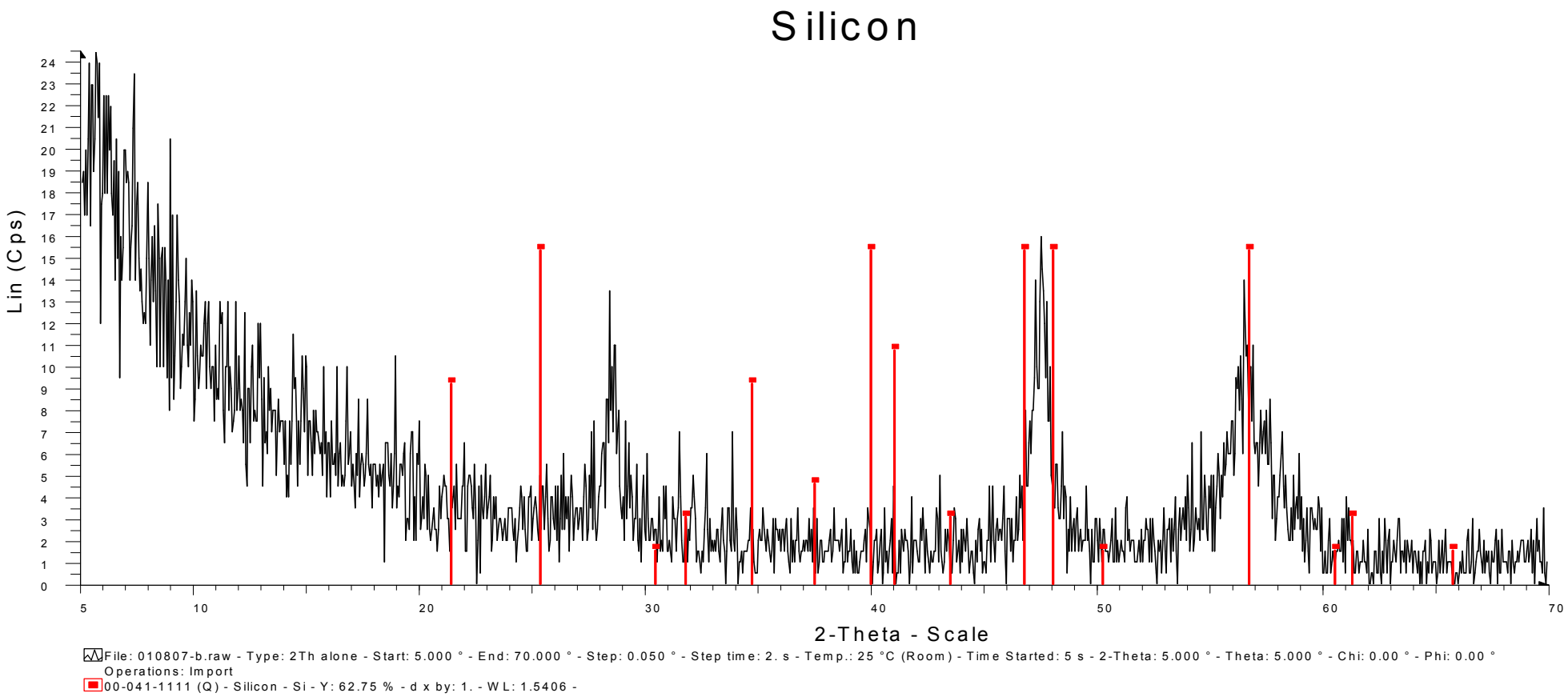
B2. Performance chart for deposition chamber.



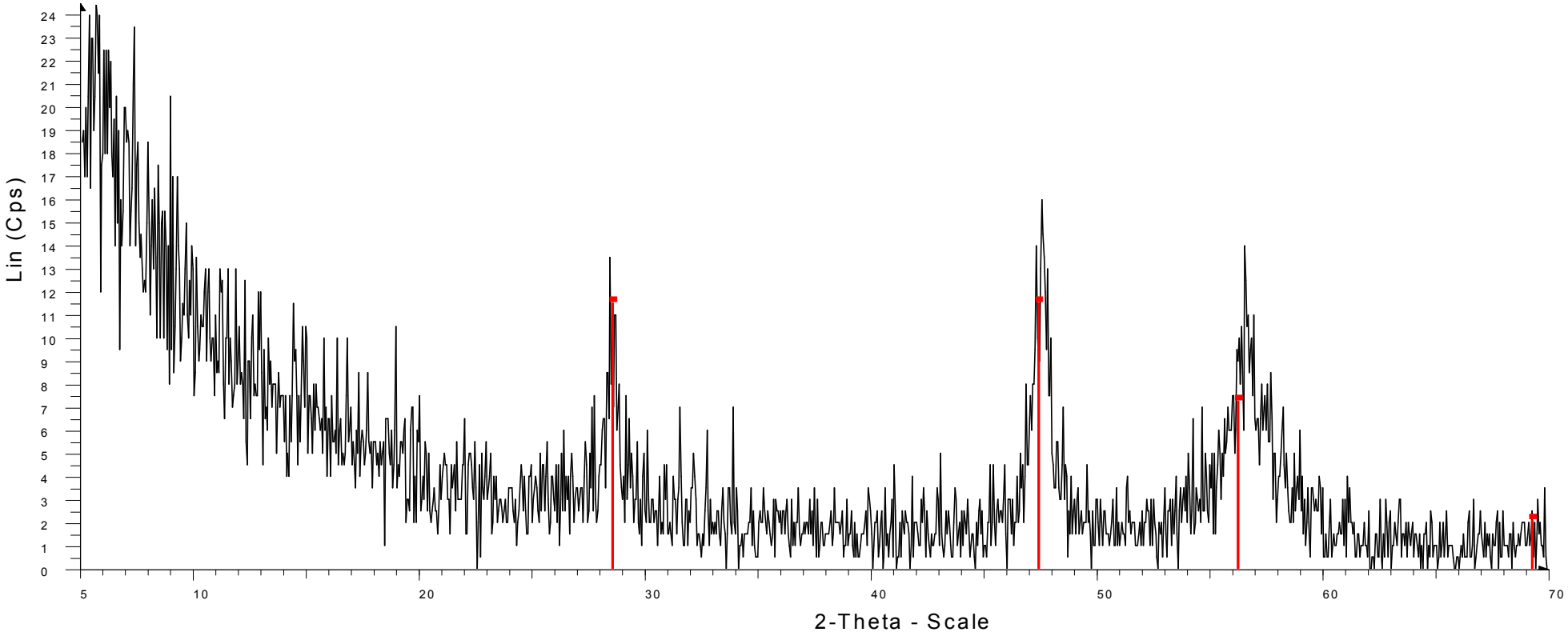




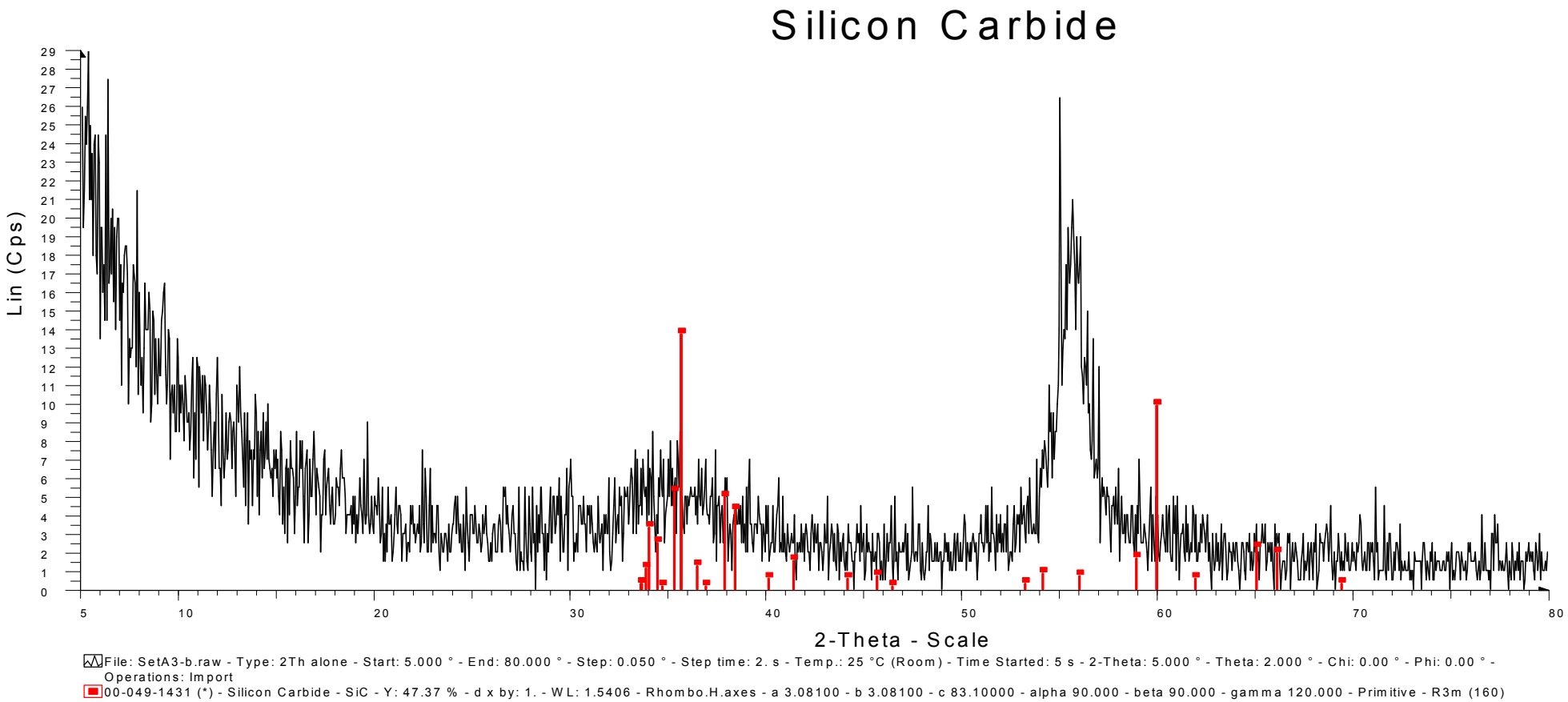
B3. Example of XRD spectrum for Silicon and Silicon Carbide



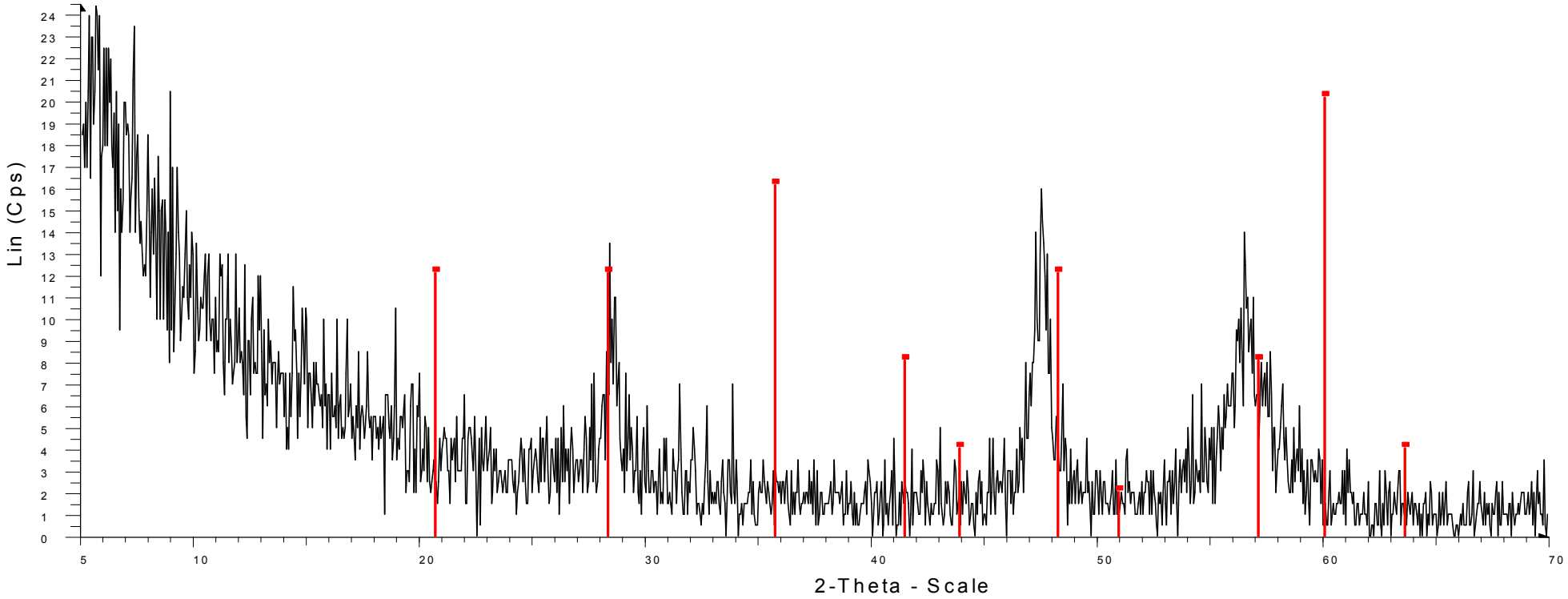
Silicon



File: 010807-b.raw - Type: 2Th alone - Start: 5.000 ° - End: 70.000 ° - Step: 0.050 ° - Step time: 2. s - Temp.: 25 °C (Room) - Time Started: 5 s - 2-Theta: 5.000 ° - Theta: 5.000 ° - Chi: 0.00 ° - Phi: 0.00 °
Operations: Import
00-001-0791 (D) - Silicon - Si - Y: 46.96 % - d x by: 1. - WL: 1.5406 - Cubic - a 5.42000 - b 5.42000 - c 5.42000 - alpha 90.000 - beta 90.000 - gamma 90.000 - Face-centered - Fd-3m (227) - 8 - 159.220


Silicon Carbide
Lin (Cps)
2-Theta - Scale
File: SetA3-b.raw - Type: 2Th alone - Start: 5.000 ° - End: 80.000 ° - Step: 0.050 ° - Step time: 2. s - Temp.: 25 °C (Room) - Time Started: 5 s - 2-Theta: 5.000 ° - Theta: 2.000 ° - Chi: 0.00 ° - Phi: 0.00 ° -
Operations: Import
00-049-1431 (*) - Silicon Carbide - SiC - Y: 47.37 % - d x by: 1. - WL: 1.5406 - Rhombo.H.axes - a 3.08100 - b 3.08100 - c 83.10000 - alpha 90.000 - beta 90.000 - gamma 120.000 - Primitive - R3m (160)

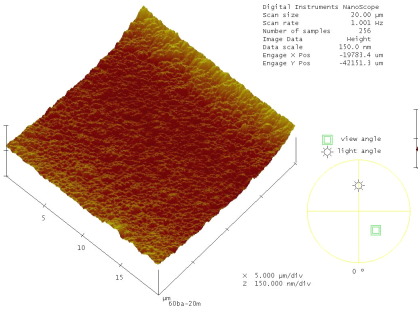
Silicon Carbide



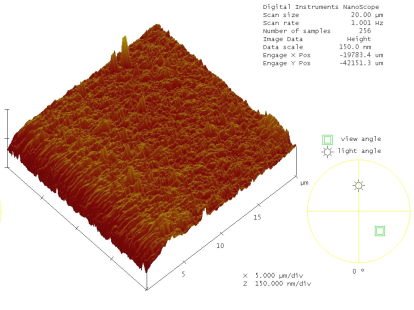
APPENDIX C

Morphology studies

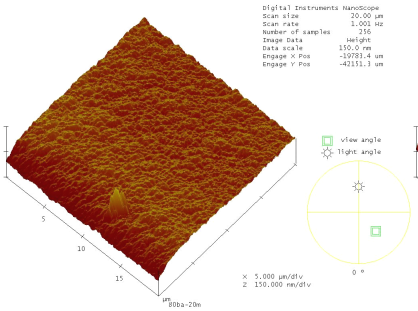
C1. AFM images of SiC thin films prepared by RF-PECVD technique.



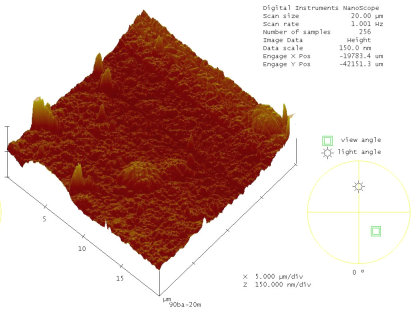
R=1.5



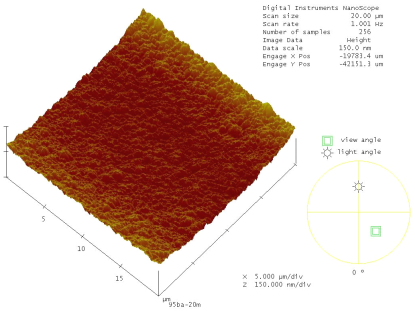
R=2.4



R=4.0

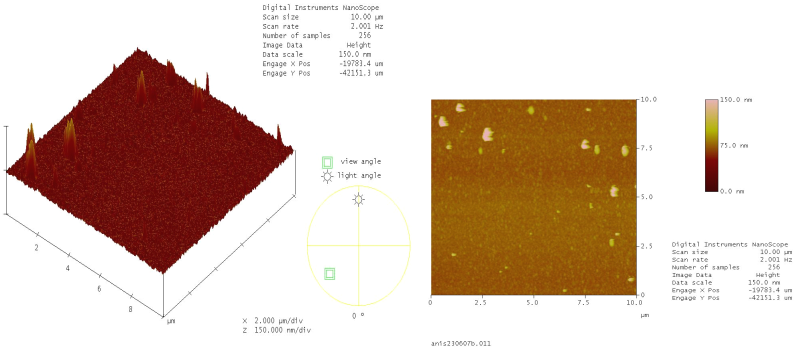


R=9.0

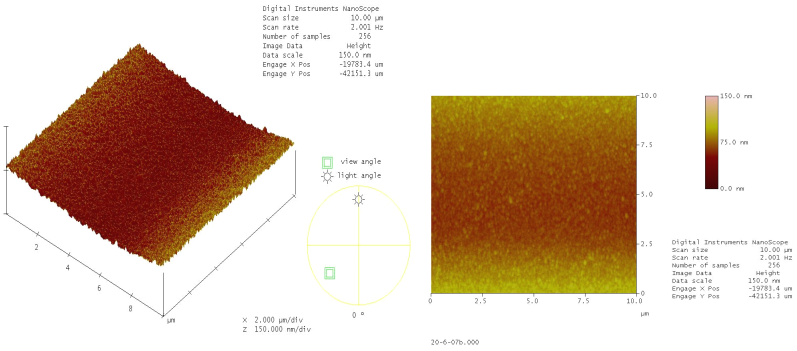


R=20

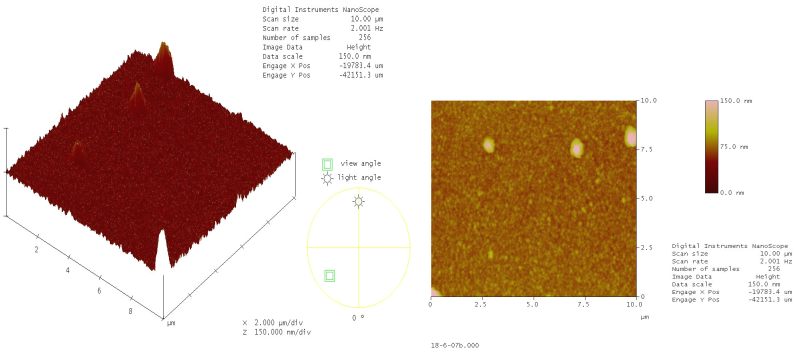
C2. (a)AFM images of SiC thin films prepared by DC-PECVD technique.



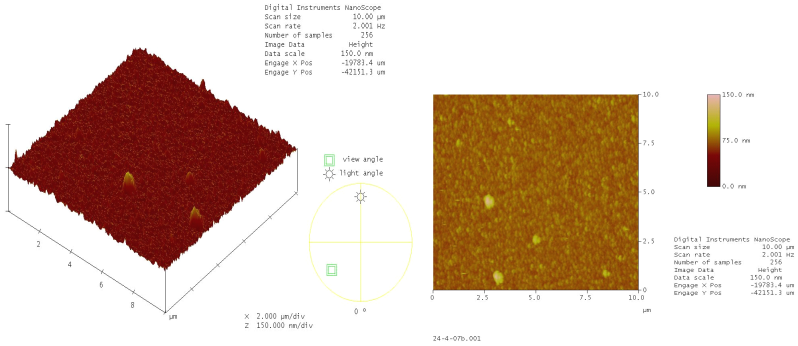
R=2



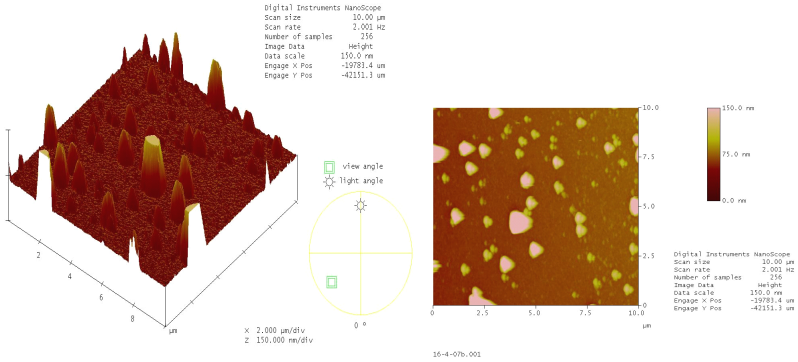
R=4



R=6

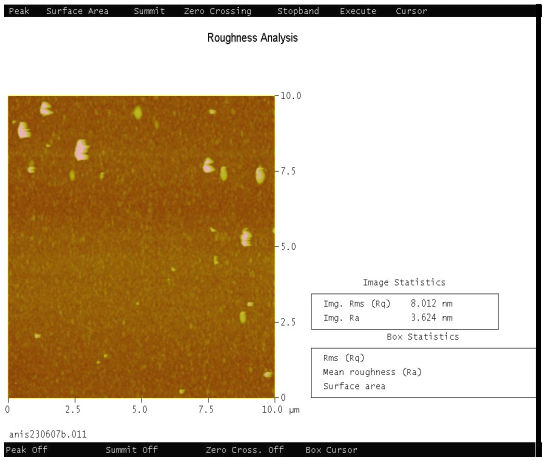

Digital Instruments NanoScope
Scan size 10.00 µm
Scan rate 2.001 Hz
Number of samples 256
Image Data Height
Data scale 150.0 nm
Engage X Pos -19783.4 um
Engage Y Pos -42151.1 um
view angle
light angle
X 2.000 µm/div
Z 150.000 nm/div
150.0 nm
75.0 nm
0.0 nm
24-4-07b.001

R=10

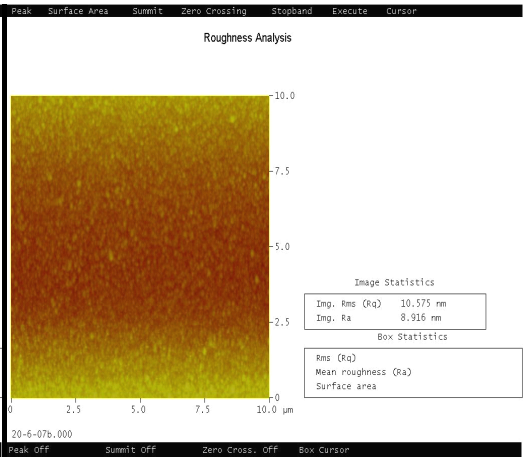

Digital Instruments NanoScope
Scan size 10.00 µm
Scan rate 2.001 Hz
Number of samples 256
Image Data Height
Data scale 150.0 nm
Engage X Pos -19783.4 um
Engage Y Pos -42151.1 um
view angle
light angle
X 2.000 µm/div
Z 150.000 nm/div
150.0 nm
75.0 nm
0.0 nm
16-4-07b.001

R=14

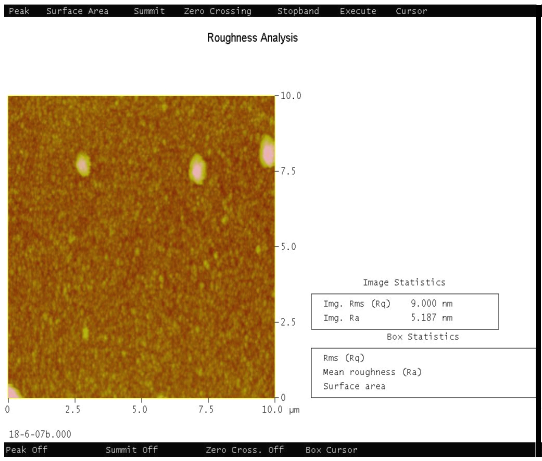
C2. (b)Roughness analysis of SiC thin films prepared by DC-PECVD technique.



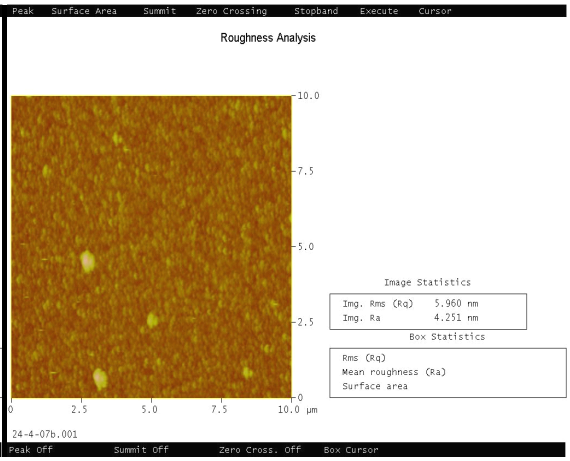
R=2



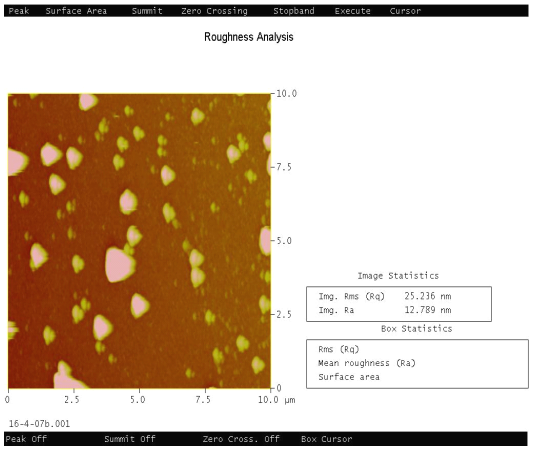
R=4



R=6

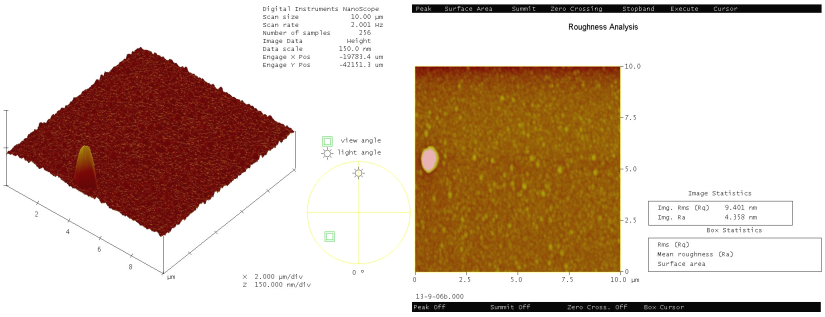


R=10

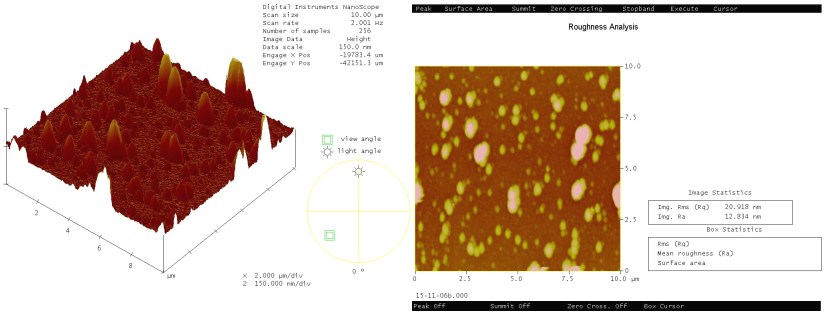


R=14

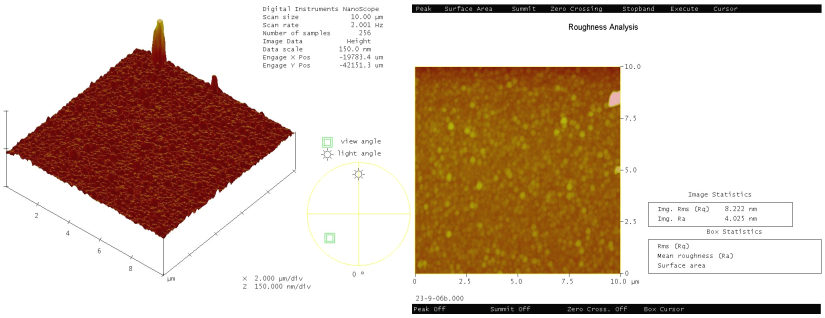
C3. AFM images of SiC thin films prepared by HW-CVD technique.



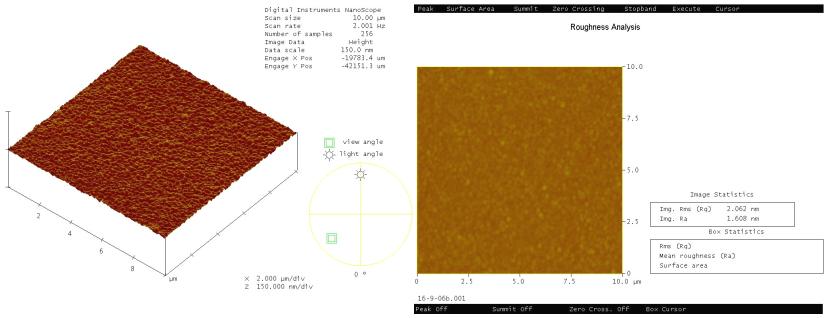
R=2



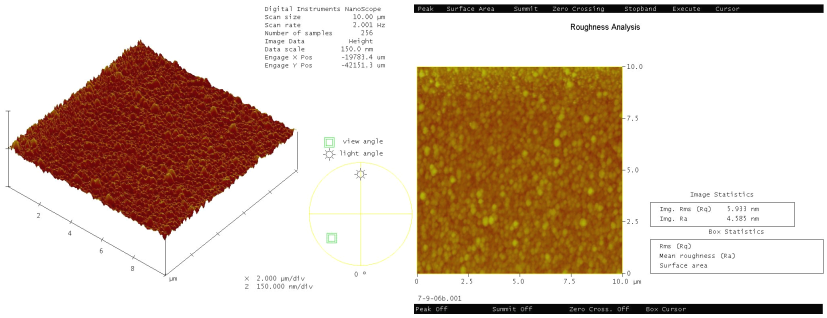
R=4



R=6

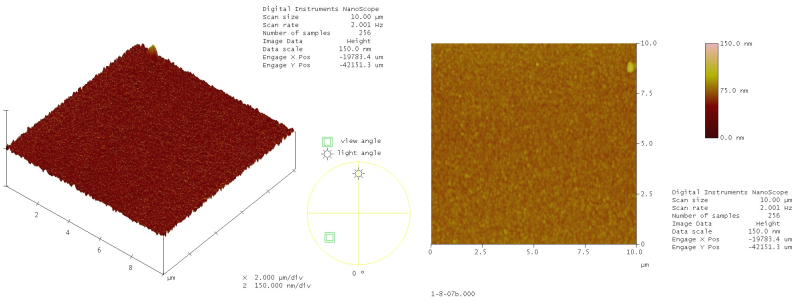

Digital Instruments NanoScope
Scan size 10.00 µm
Scan rate 2.001 Hz
Number of samples 256
Image Data Height
Data scale 150.0 nm
Engage X Pos -19783.4 um
Engage Y Pos -42151.1 um
view angle
light angle
X 2.000 µm/div
Z 150.000 nm/div
Peak Surface Area Summit Zero Crossing Stopband Execute Cursor
Roughness Analysis
Image Statistics
Img. Rms (Rq) 2.062 nm
Img. Ra 1.608 nm
Box Statistics
Rms (Rq)
Mean roughness (Ra)
Surface area
16-9-06b.001
Peak OFF Summit OFF Zero Cross. OFF Box Cursor

R=10

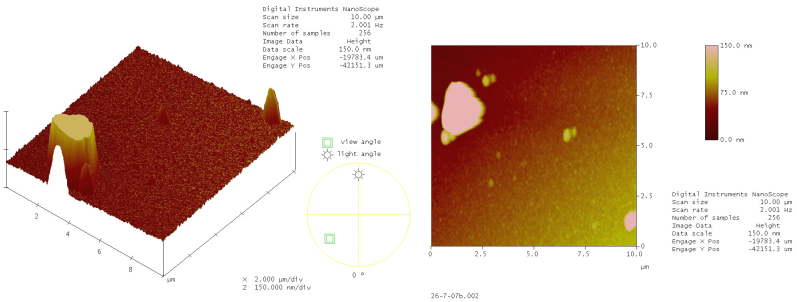

Digital Instruments NanoScope
Scan size 10.00 µm
Scan rate 2.001 Hz
Number of samples 256
Image Data Height
Data scale 150.0 nm
Engage X Pos -19783.4 um
Engage Y Pos -42151.1 um
view angle
light angle
X 2.000 µm/div
Z 150.000 nm/div
Peak Surface Area Summit Zero Crossing Stopband Execute Cursor
Roughness Analysis
Image Statistics
Img. Rms (Rq) 5.933 nm
Img. Ra 4.585 nm
Box Statistics
Rms (Rq)
Mean roughness (Ra)
Surface area
7-9-06b.001
Peak OFF Summit OFF Zero Cross. OFF Box Cursor

R=14

C4. (a)AFM images of SiC thin films prepared by hybrid HW-PECVD technique with hydrogen dilution.

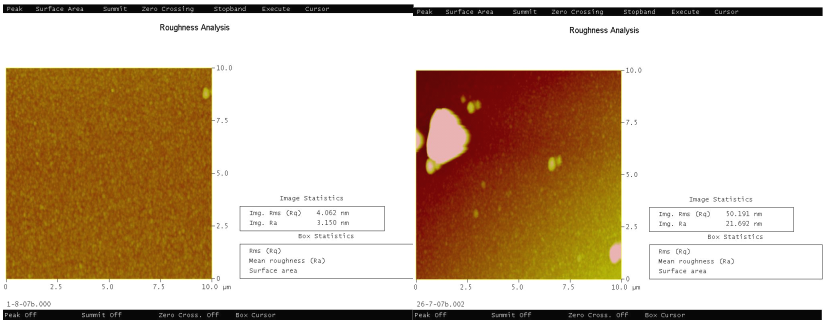


R=2 with hydrogen dilution.



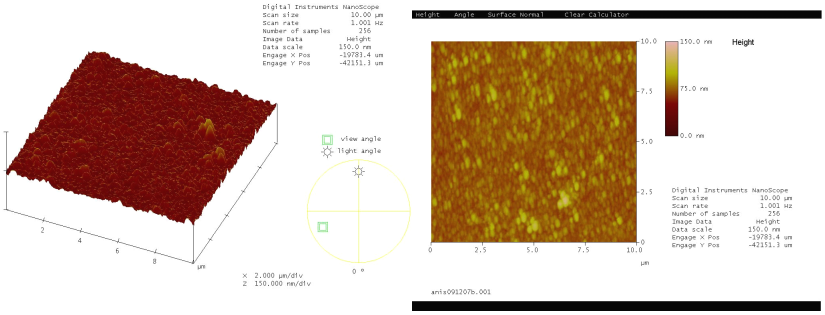
R=14 with hydrogen dilution.

C4. (b)Roughness analysis of SiC thin films prepared by hybrid HW-PECVD technique with hydrogen dilution.

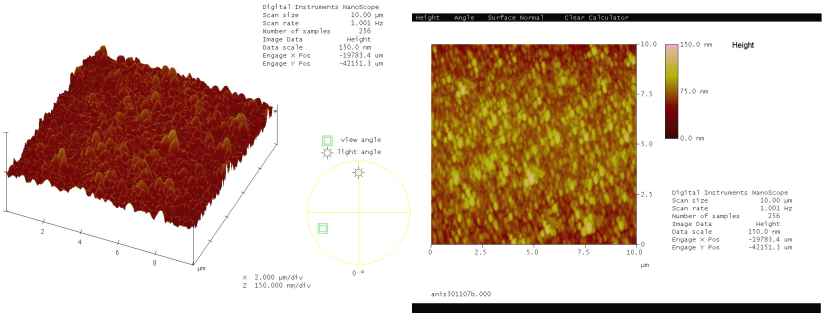


R=2 with hydrogen dilution. *R*=14 with hydrogen dilution.

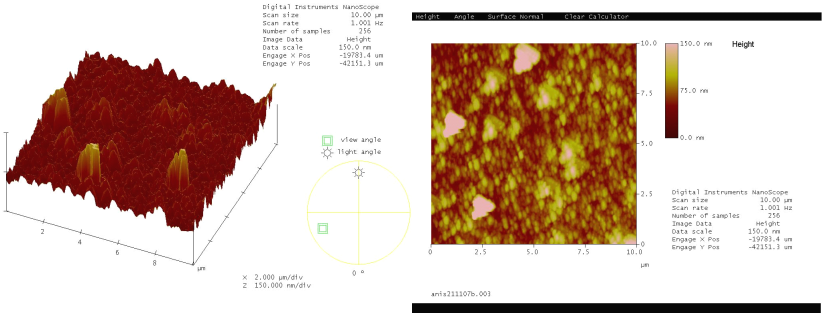
C5. AFM images of SiC thin films prepared by hybrid HW-PECVD technique with hydrogen surface treatment.



Treatment time = 3 minutes



Treatment time = 2 minutes



Treatment time = 1 minute