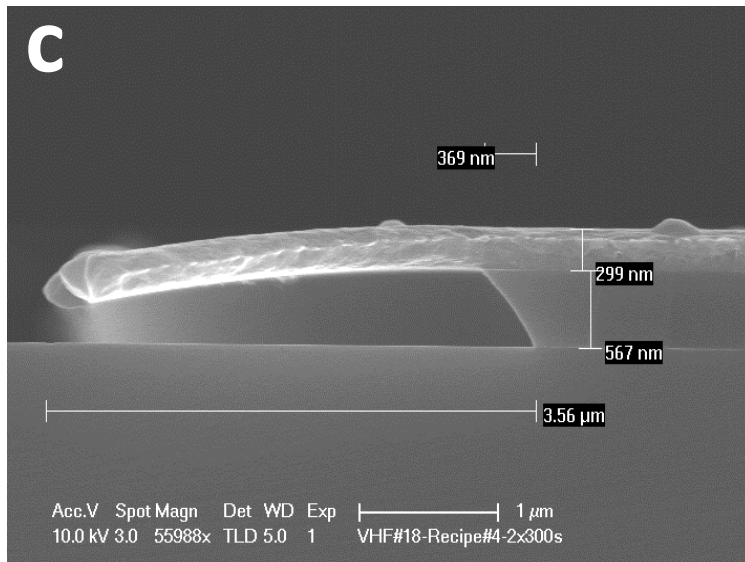
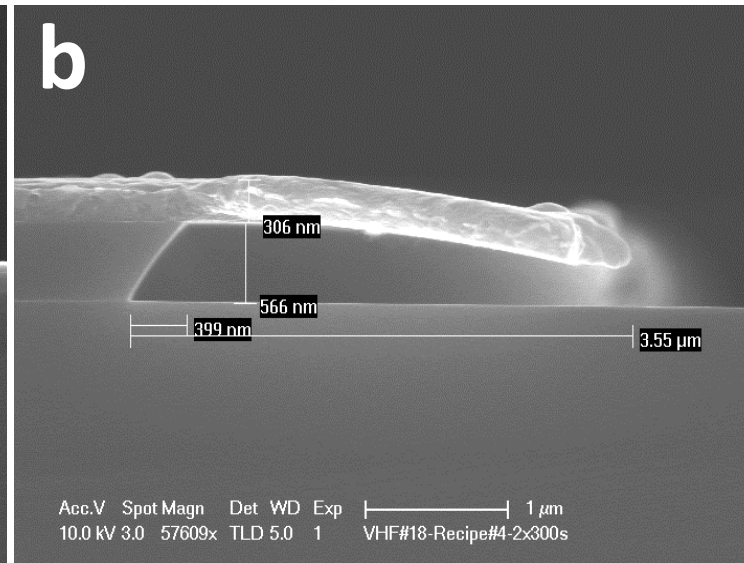
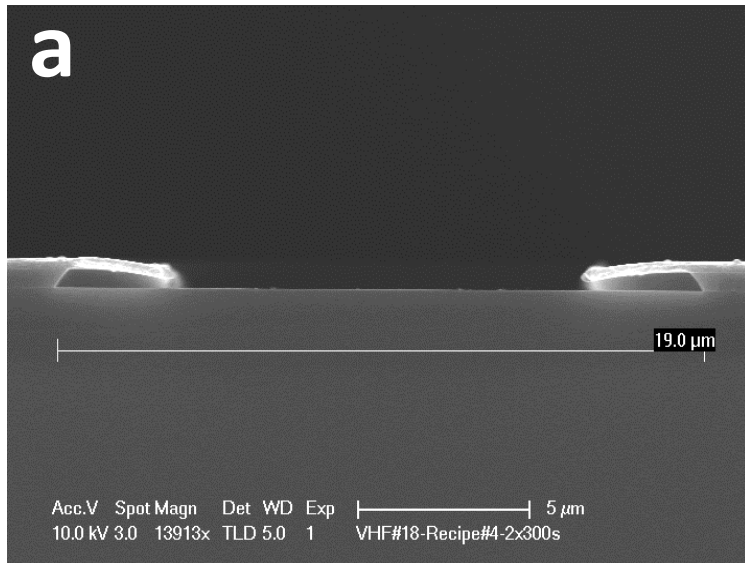


Figure 14 (a), (b), and (c): Dry etch profile of SiO<sub>2</sub> using VHF tool and **Recipe#4 with 2X300 s** (2 cycles and 300 s for each cycle).

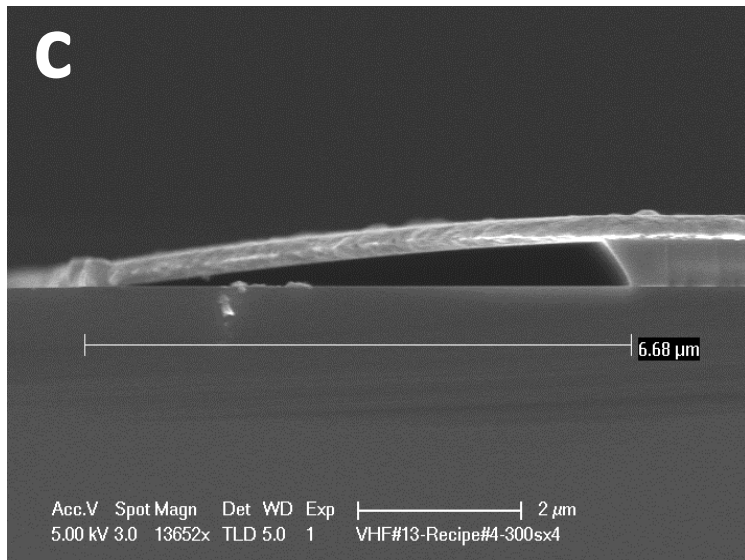
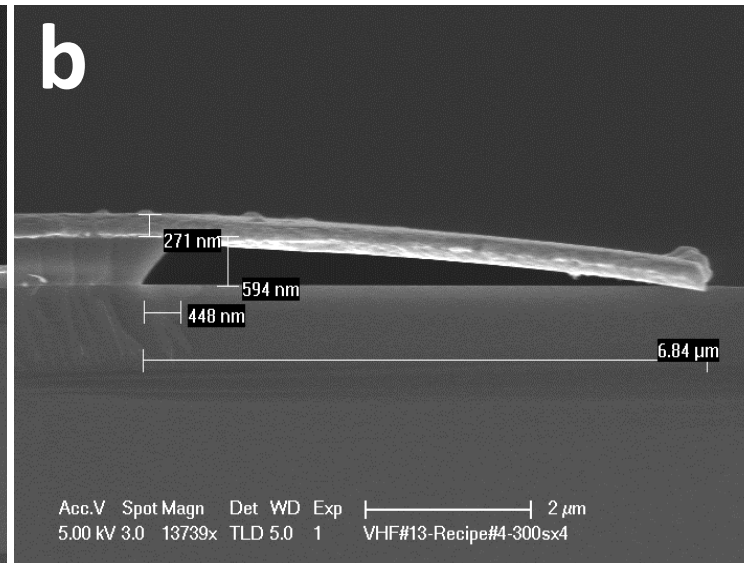
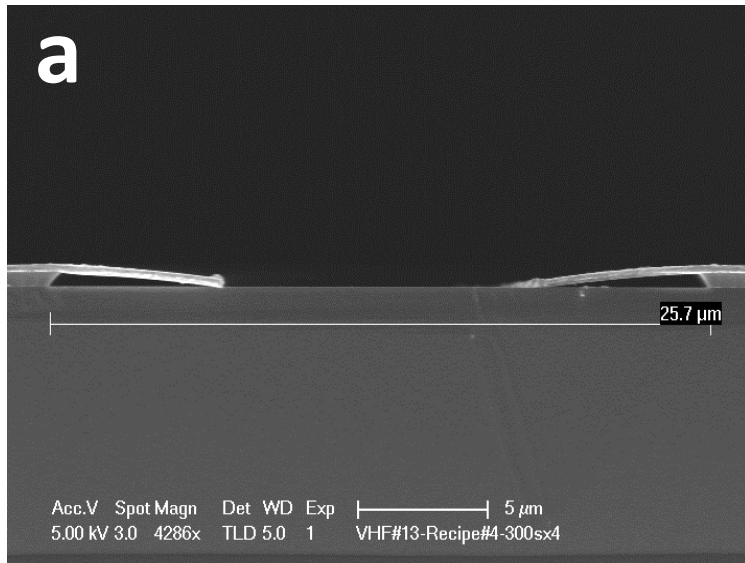


**Average opening width (including the undercuts)  
= 19.1  $\mu\text{m}$**

**Average Undercut= (19.1-12.1)/2=3.5  $\mu\text{m}$**

**Undercut etch rate=3.5  $\mu\text{m}$ /10min=3500  $\text{Å}/\text{min}$**

Figure 15 (a), (b), and (c): Dry etch profile of SiO<sub>2</sub> using VHF tool and **Recipe#4 with 4X300 s** (4 cycles and 300 s for each cycle).

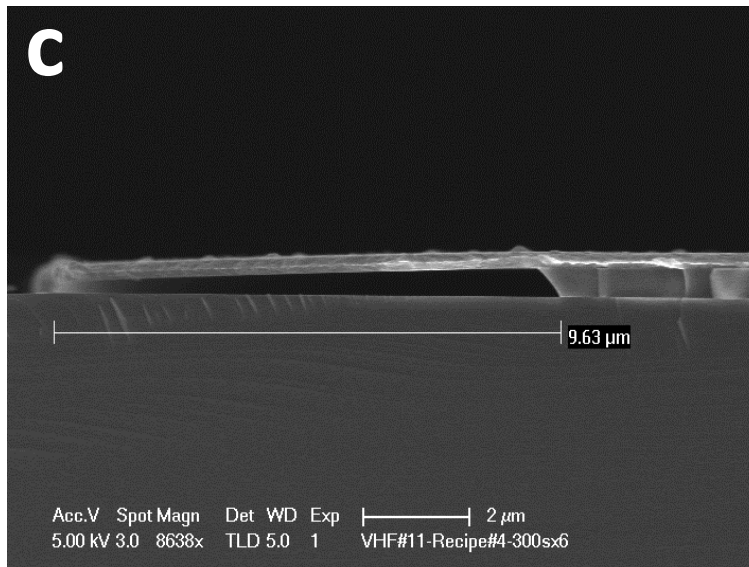
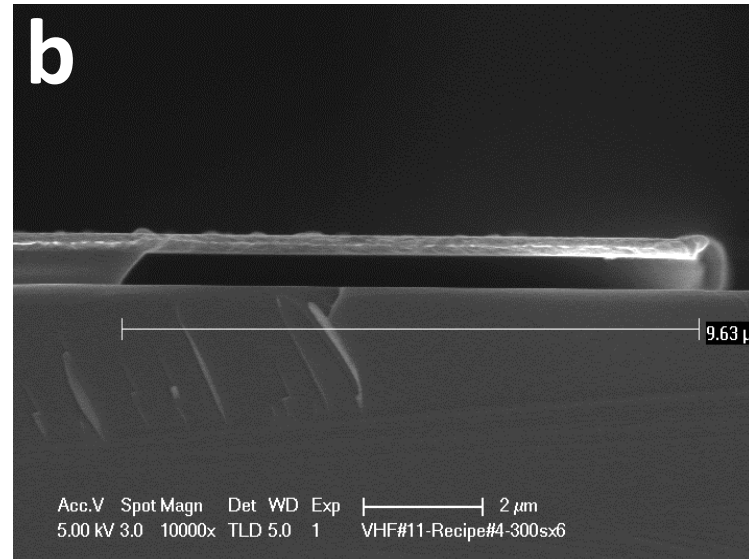
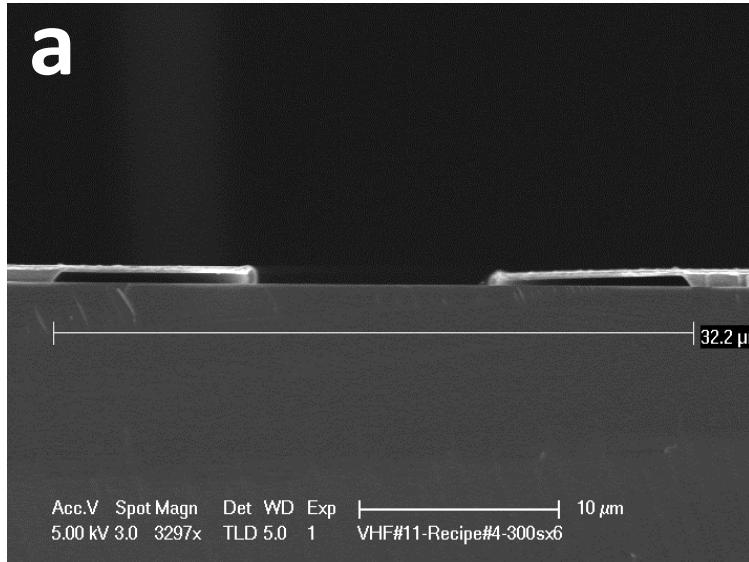


**Average opening width (including the undercuts) = 25.7 μm**

**Average Undercut = (25.7 - 12.1) / 2 = 6.8 μm**

**Undercut etch rate = 6.8 μm / 20 min = 3400 Å/min**

Figure 16 (a), (b), and (c): Dry etch profile of SiO<sub>2</sub> using VHF tool and **Recipe#4 with 6X300 s** (6 cycles and 300 s for each cycle).



**Average opening width (including the undercuts) = 32.1 μm**

**Average Undercut =  $(32.1 - 12.1) / 2 = 10 \mu\text{m}$**

**Undercut etch rate =  $10 \mu\text{m} / 30 \text{min} = 3330 \text{ \AA} / \text{min}$**

Figure 17 SiO<sub>2</sub> undercut vs. etch time using Recipe#4.

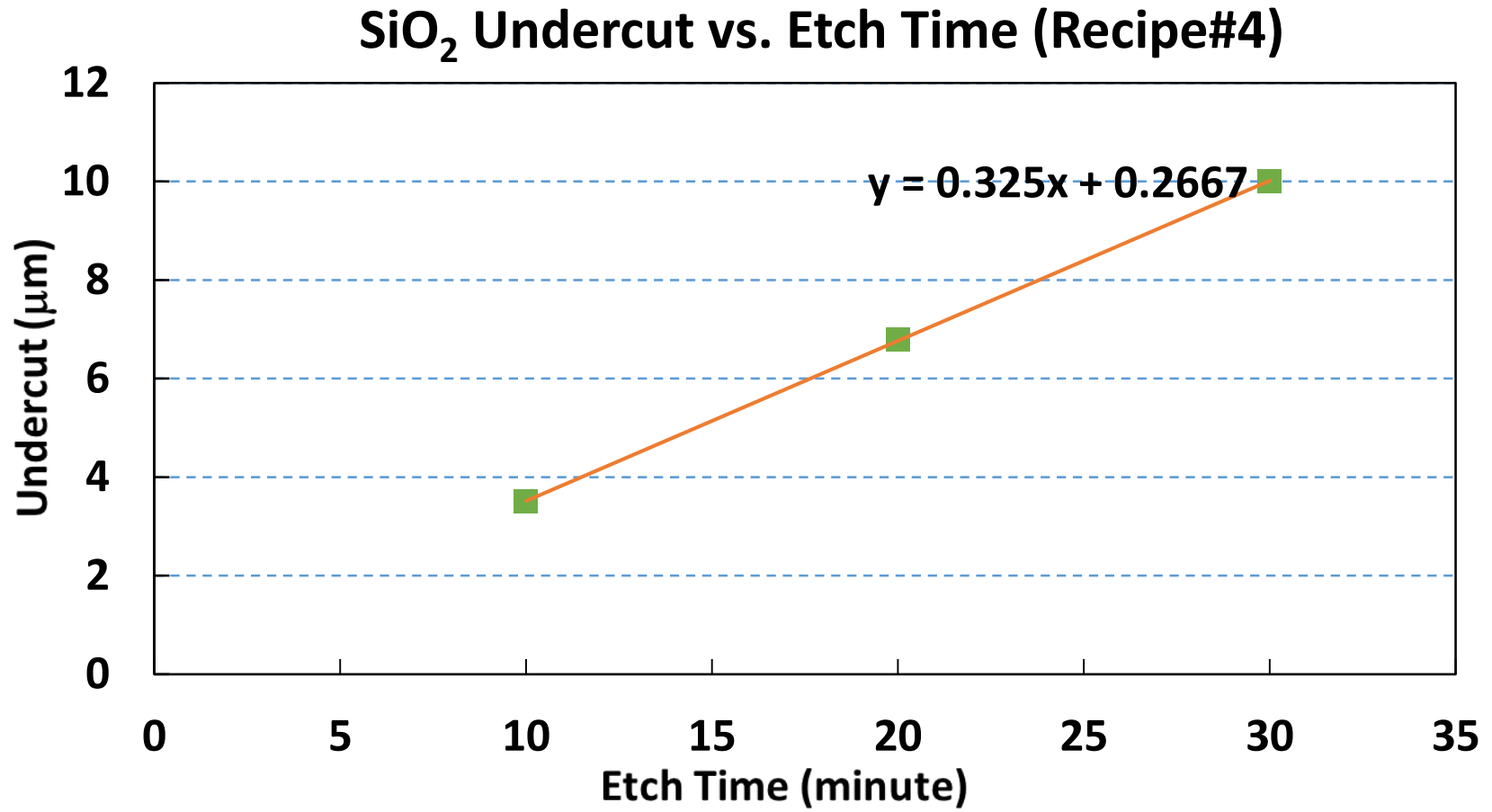
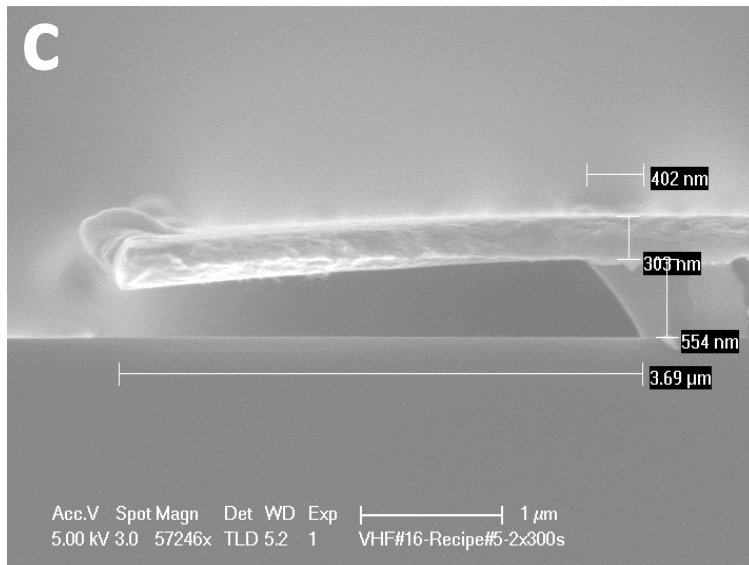
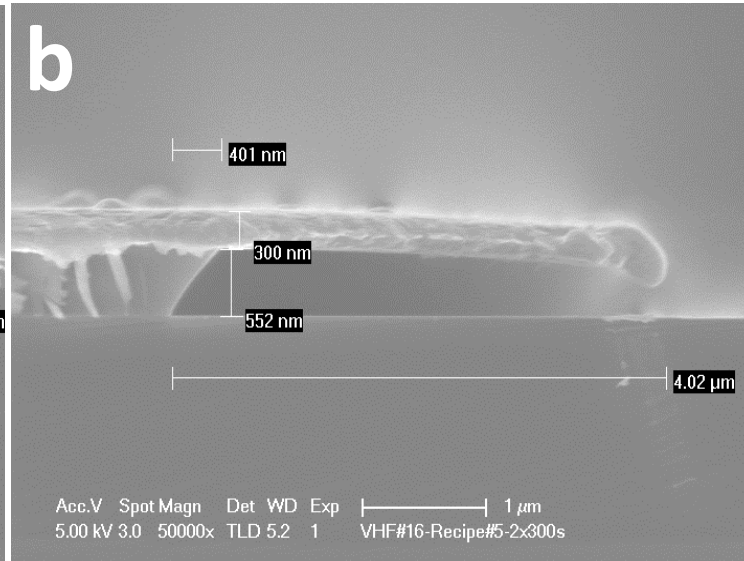
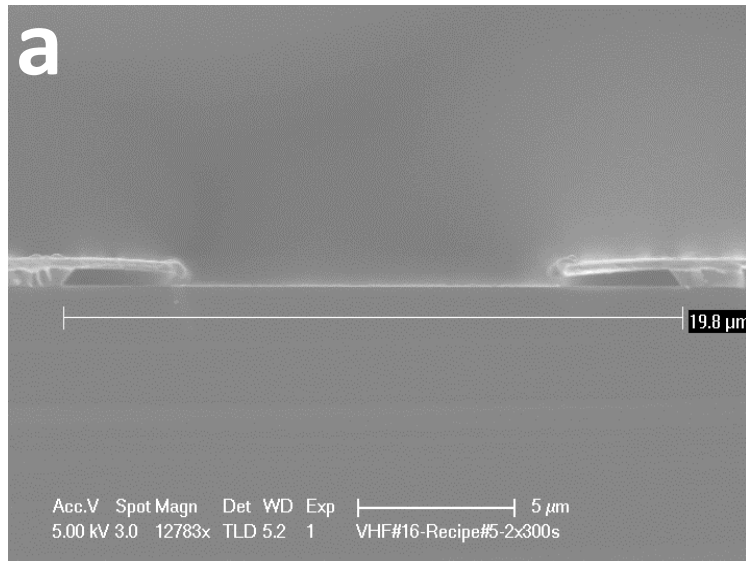


Figure 18 (a), (b), and (c): Dry etch profile of SiO<sub>2</sub> using VHF tool and **Recipe#5 with 2X300 s** (2 cycles and 300 s for each cycle).

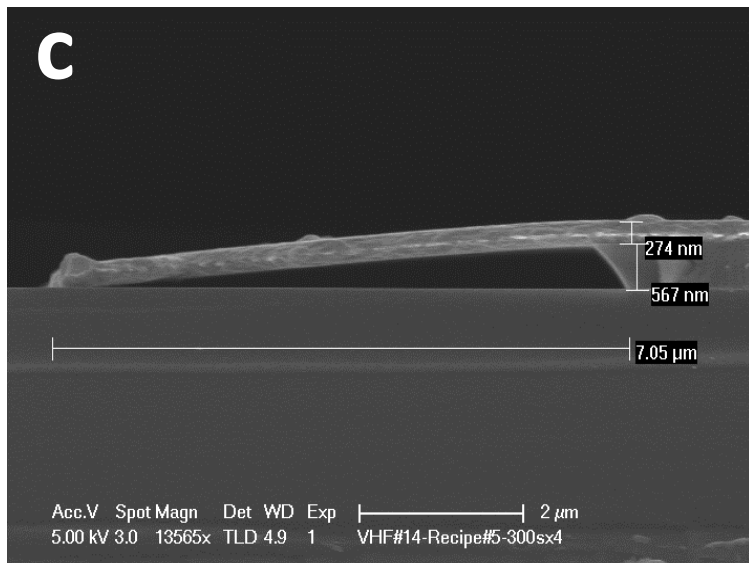
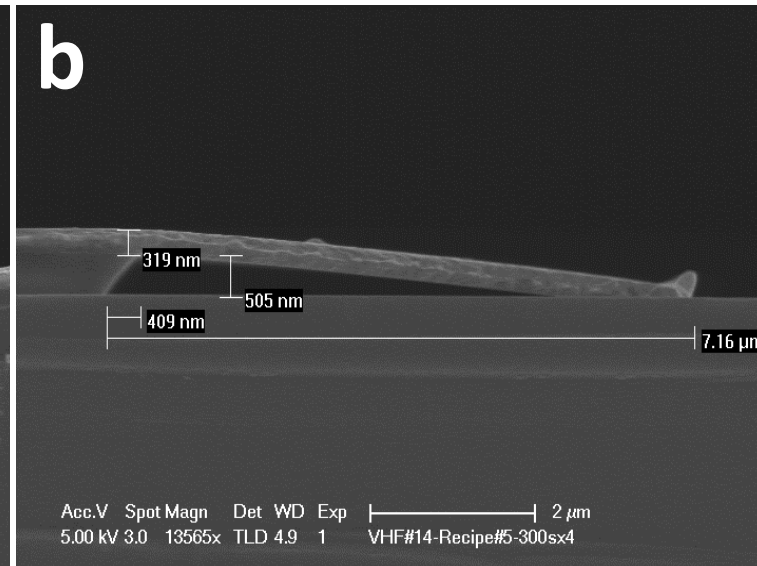
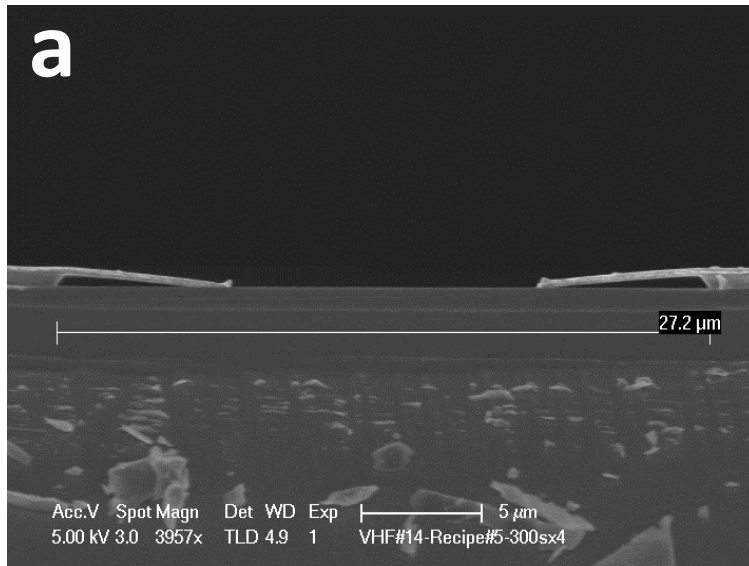


**Average opening width (including the undercuts) = 19.8  $\mu\text{m}$**

**Average Undercut =  $(19.8 - 12.1) / 2 \approx 3.85 \mu\text{m}$**

**Undercut etch rate =  $3.85 \mu\text{m} / 10 \text{min} = 3850 \text{ \AA} / \text{min}$**

Figure 19 (a), (b), and (c): Dry etch profile of SiO<sub>2</sub> using VHF tool and **Recipe#5 with 4X300 s** (4 cycles and 300 s for each cycle).

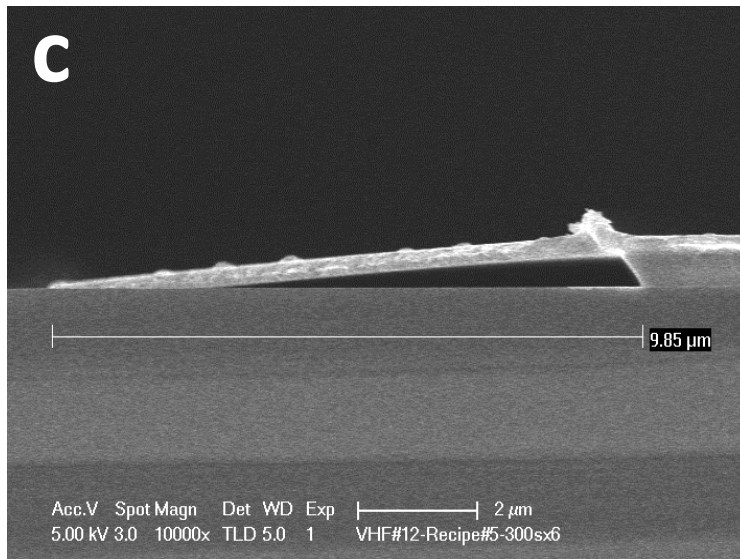
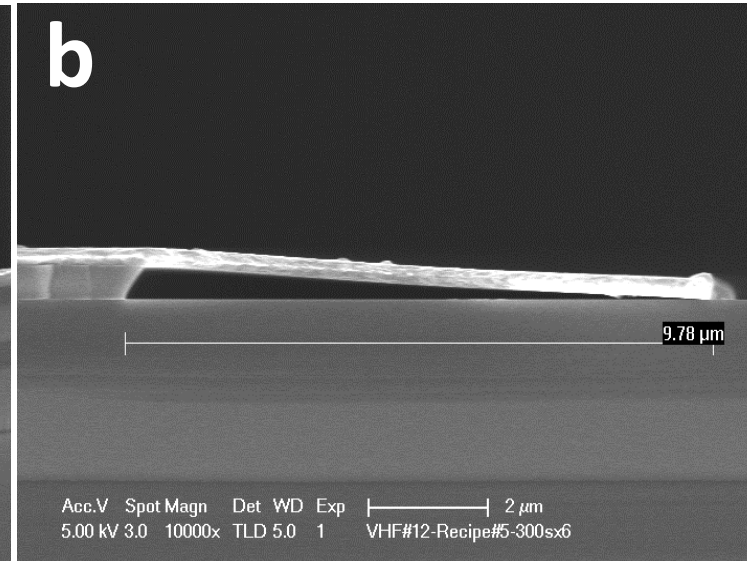
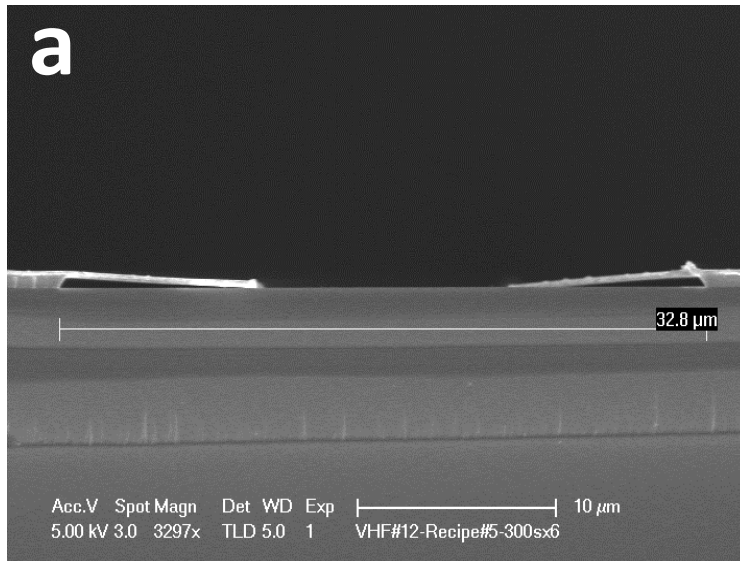


***Average opening width (including the undercuts) = 27.0  $\mu\text{m}$***

***Average Undercut= (27.0-12.1)/2≈7.45 $\mu\text{m}$***

***Undercut etch rate=7.45 $\mu\text{m}$ /20min=3730  $\text{\AA}$ /min***

Figure 20 (a), (b), and (c): Dry etch profile of SiO<sub>2</sub> using VHF tool and **Recipe#5 with 6X300 s** (6 cycles and 300 s for each cycle).

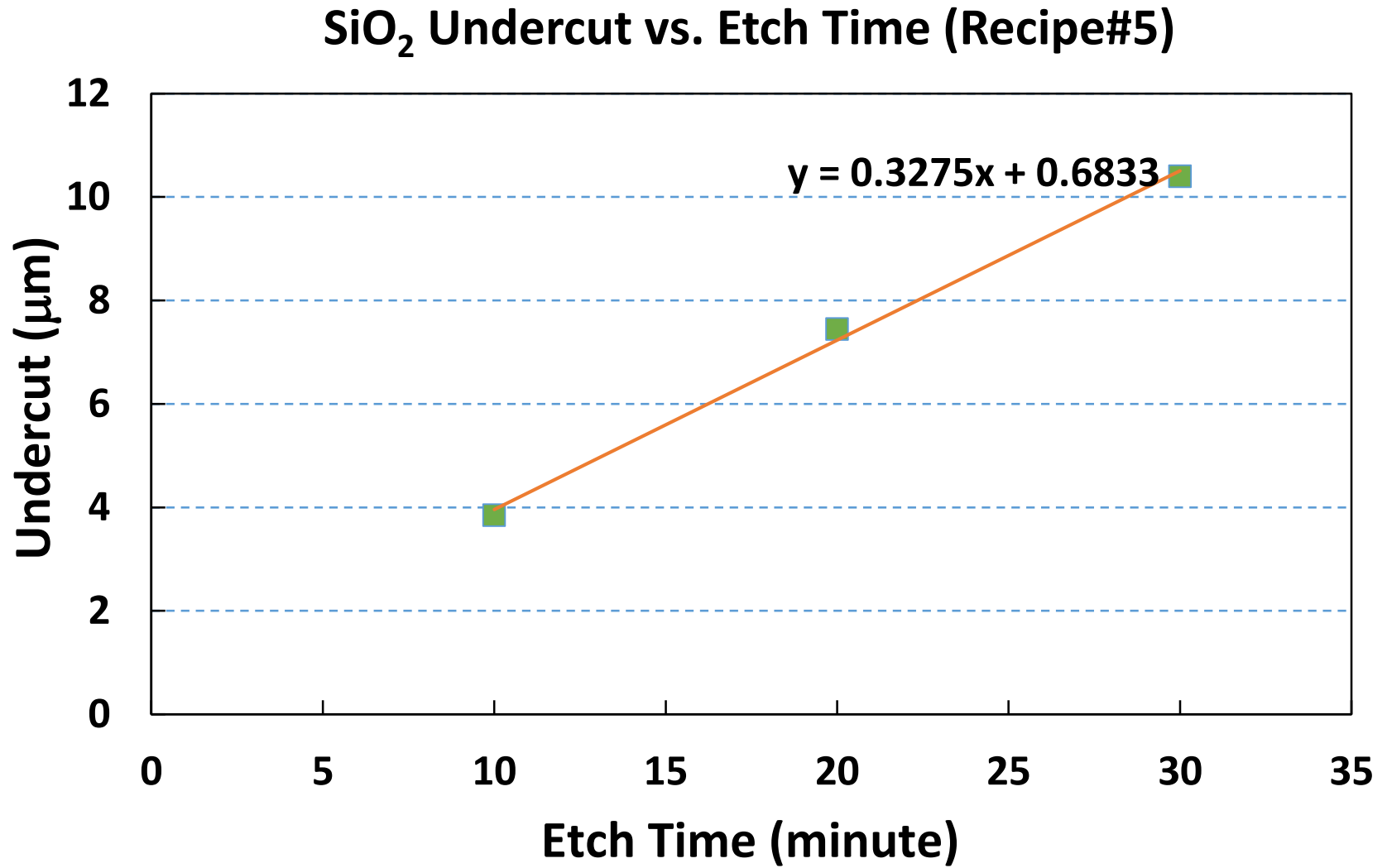


**Average opening width (including the undercuts) = 32.9 μm**

**Average Undercut =  $(32.9 - 12.1) / 2 \approx 10.4 \mu\text{m}$**

**Undercut etch rate =  $10.4 \mu\text{m} / 30\text{min} = 3470 \text{ \AA} / \text{min}$**

Figure 21 SiO<sub>2</sub> undercut vs. etch time using Recipe#5.





**Table 2 Vapor HF partial pressure and EtOH partial pressure vs SiO<sub>2</sub> undercut etch rate.**

Recipe#	HF Partial Pressure (T)	EtOH Partial Pressure (T)	SiO <sub>2</sub> Undercut Etch Rate (Å/min)
1	13.0	14.4	177
2	20.3	22.9	1100
3	34.1	26.0	2390
4	39.3	26.2	3410
5	46.8	21.1	3680

Figure 22 SiO<sub>2</sub> undercut etch rate vs vapor HF partial pressure.

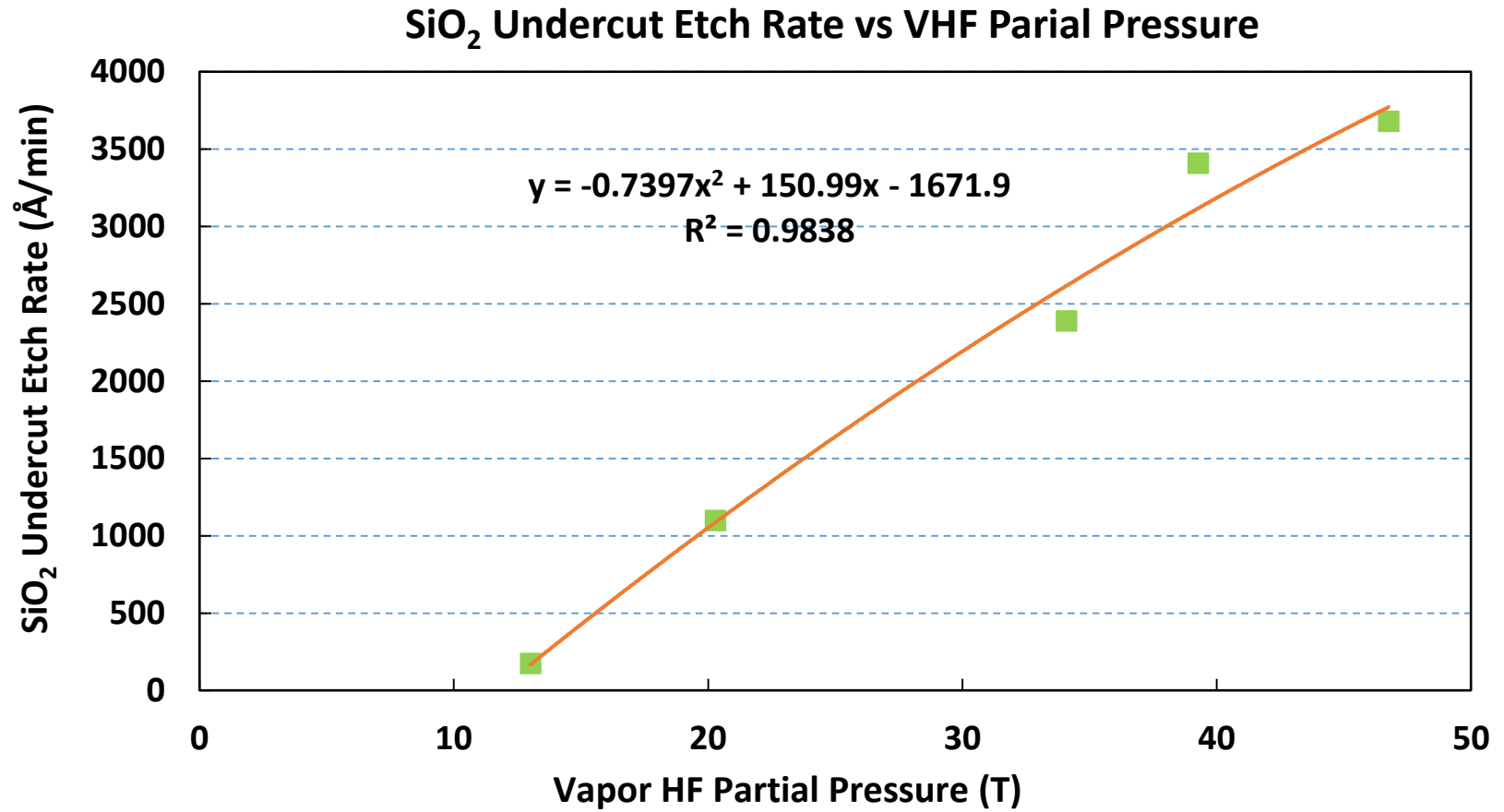


Figure 23 SiO<sub>2</sub> undercut etch rate vs vapor EtOH partial pressure.

