SILICON DIOXIDE PLASMA ETCH GUIDE

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Purpose: Plasma etch rates of SiO2 and resist 1827 for several recipes and 2 tools

Processes: Trion and March plasma etching of thermal SiO_2 (silicon dioxide)

Restrictions/requirements: General cleanroom safety training, training on the Trion and March RIE from cleanroom personnel

Limitations: Reproducibility is governed by a stable DC bias during the etch

Oxide Etch Rate (nm/min)	Shipley 1827 Resist Etch Rate (nm/min)	ICP/Refl (W)	RIE/Refl (W)	DC Bias (V)	Gas 1 (sccm)	Gas 2 (sccm)	He Cooling (Torr)	Pressure (mTorr)	Tool	Comments
80.4		400/10	50/6	-124	CHF3, 40	O2, 3	5	20	Trion	
131		400/10	100/10	-150 to -200	CHF3, 40	O2, 0	5	20	Trion	
98.6	**>230**	400/10	100/9	-150 to -200	CHF2, 30	CF4, 10	5	20	Trion	
112.4, 118†	**> 260, 390†**	NA	300/3	?	CF4, 50%	H2, 3%	NA	300	March	
14	**44**	300/6	25/9	-27 to -23	CHF3, 30	CF4, 10	5	20	Trion	
54.4, 68.4, 50, 57.9†	**61, 96.2, 58.4, 72.3†**	300/7, 300/17	50/6, 50/7	-150 to -90	CHF3, 40	0	5	20	Trion	Hard baked 1827 for 1hr at 115°C, hard bake 5 min
80, 82.3	**-133.8, -187.2‡**	300/17	100/12	-200 to -300	CHF3 40	0	5	20	Trion	Hard bake 5 min

† More than one value indicates results of separate trials.

‡ Resist thickness actually increased during the first 5 minutes of the etch

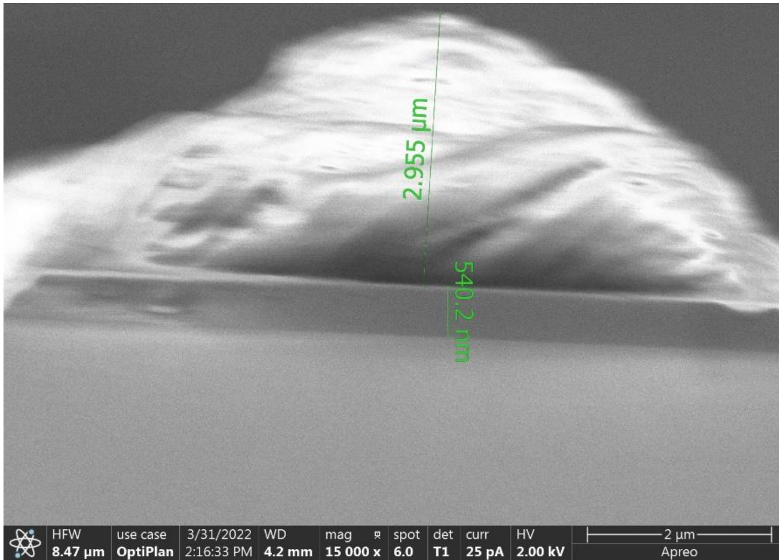
<u>Best recipe for resist selectivity from above is the last:</u>

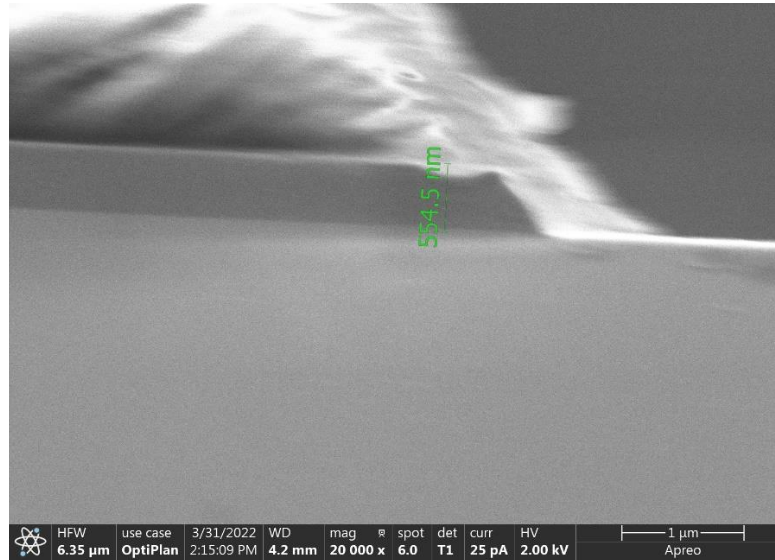
Using the Trion Plasma Etcher with resist hard baked for 5 min at 115°C
ICP: 300 W Ref: 17 RIE 100 ref: 12 DC Bias: -200 to -300 V
He: 5 torr CHF_3: 40 sccm O_2: 0 Pressure: 20 mT
NOTE: Resist thickness actually increases due to incorporation of fluorine and sulfur

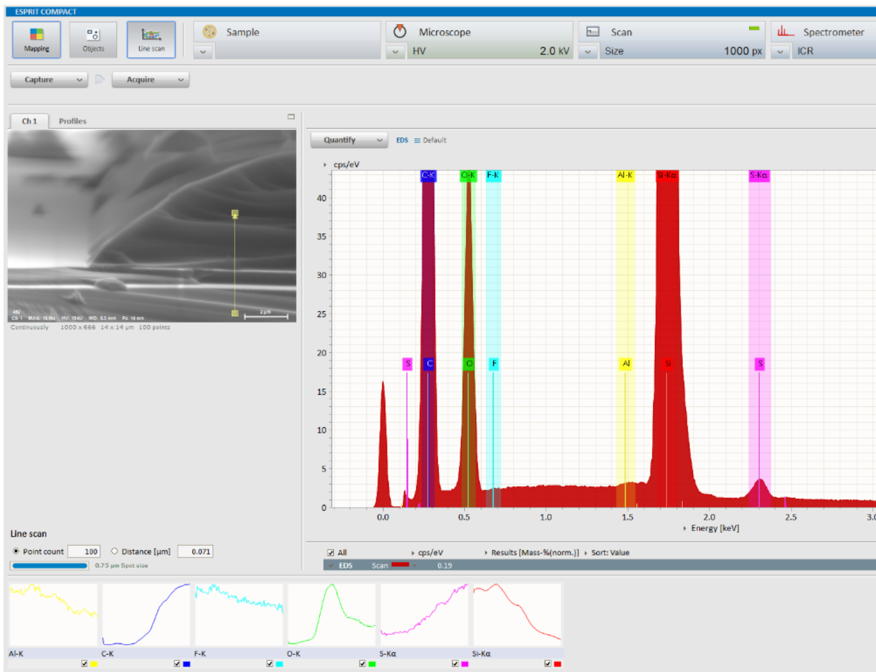
Under Cut and EDS of Resist

ICP: 300 W Ref: 7 RIE: 50 ref: 2 DC Bias: -150 to -90 V

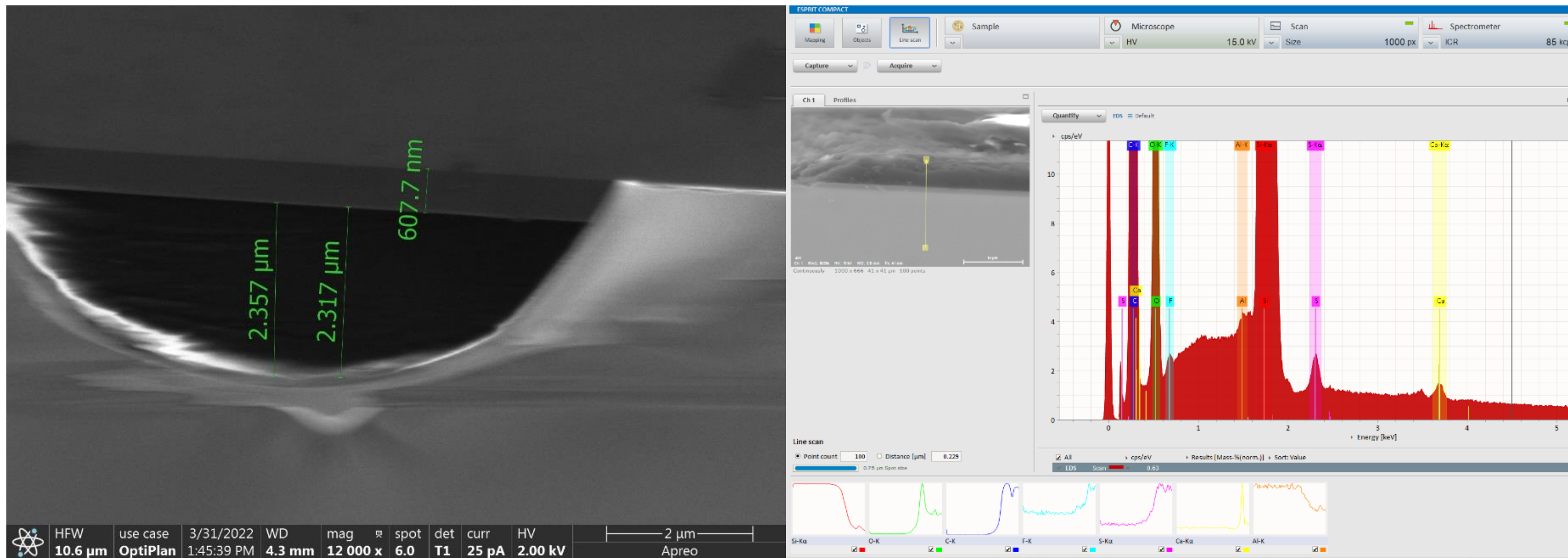
He: 5 torr CHF_3: 40 sccm O_2: 0 Pressure: 20 mT







ICP: 300 W Ref: 17 RIE 100 ref: 12 DC Bias: -200 to -300 V
He: 5 torr CHF_3: 40 sccm O_2: 0 Pressure: 20 mT



Conclusions from SEM and EDS:

1. Undercut of the oxide is negligible for these thicknesses.
2. The photo resist thickness seems to have increased due to absorption of fluorine and sulfur. The fluorine is found in the etch gas CHF_3 but we are not sure about the source of the sulfur – perhaps from SF_6 used in previous runs? It is clear that a higher RIE power and thus DC bias drives more fluorine and sulfur into the resist.