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Reactive Ion Etch (RIE) of Silicon and ZEP520A Resist Mask with Tetrafluoromethane (CF₄) Using Oxford 80 Plus

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Summary/Description

This report discusses the results of etching silicon with electron beam lithography defined features in ZEP520A resist using CF₄ in the Oxford 80 Plus RIE.

Disciplines

Nanoscience and Nanotechnology

Goal:

To determine the etch rate of Si using CF₄ using the Oxford 80 Plus RIE.

Materials:

- 4 pieces of bulk Si with 300nm of [ZEP520A](#) containing 50 um by 50um square patterns exposed and developed via electron beam lithography and o-xylene, respectively

Equipment:

- Oxford 80 Plus RIE
- Filmetrics F40
- KLA Tencor P7
- Anatech SCE-106 Barrel Asher

Etch Recipe:

- CF4 gas flow is 20 sccm
- Pressure is 65 mTorr
- RF power is 150 W

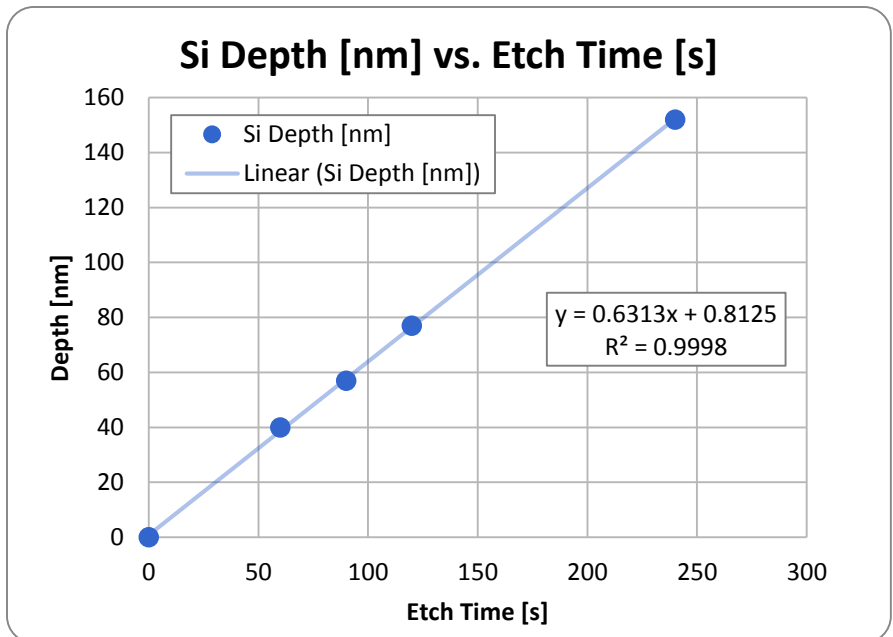
Protocol:

1. Using the etch recipe, etch each piece at various time intervals.
2. Using the Filmetrics F40 measure the remaining film thickness of the ZEP520A.
3. Strip the ZEP520A using the Anatech SCE-106 Barrel Asher using an O2 plasma at 300W for 5 minutes.
4. Using the KLA Tencor P7, measure the final step height of the Si across an edge of a 50um square.

Results:

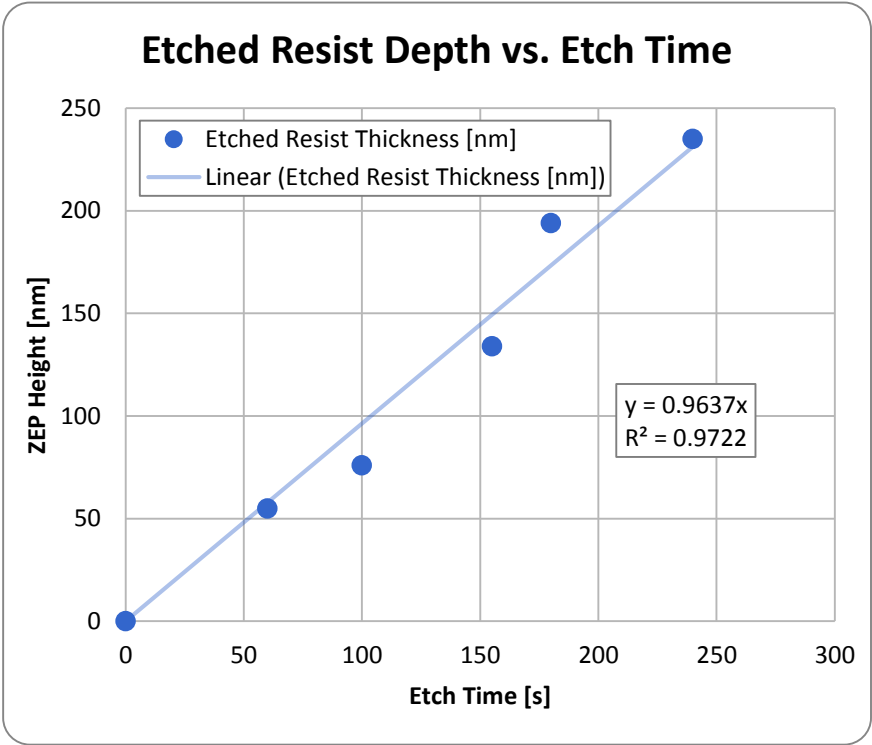
The following table is the etch time using the recipe above and the measured depth obtained by the KLA Tencor P7.

Etch Time [s]	Si Depth [nm]
0	0
60	40
90	57
120	77
240	152



An additional etch run was conducted to verify complete the data across the 120 second and 240 second gap. The following table is the etch time using the recipe above and the measured thickness of the ZEP520A obtained by the Filmetrics F40. The initial thickness of ZEP520A was 318nm.

Etch Time [s]	ZEP Height [nm]	Etched Resist Thickness [nm]
0	300	0
60	245	55
100	224	76
155	166	134
180	106	194
240	65	235



We can determine the selectivity of this silicon etch process to the ZEP520A resist by taking the ratio of the slopes from the trend charts for the “Etched Silicon Depth vs. Etch Time” and the “Etched Resist Depth vs. Etch Time”. The result of taking this ratio is $0.6313/0.9637 = 0.66$.

The two images below shows the resulting profile, as cross sectioned with a focused ion beam, from a 2 minute and 4 minute etch respectively.

