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Reactive Ion Etch (RIE) of Silicon Nitride (SiNx) with Tetrafluoromethane (CF4)

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Reactive Ion Etch (RIE) of Silicon Nitride (SiNx) with Tetrafluoromethane (CF4)

Summary/Description
This report discusses the CF4 etch process of SiNx using the Oxford 80 Plus RIE.

Disciplines
Nanoscience and Nanotechnology

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1. Introduction

The purpose of this document is to examine the etch properties of the Oxford 80 Plus RIE system.

2. Baseline Recipe

Units:

Gas flow rate: standard cubic centimeters per minute (sccm)
Pressure: millitorr (mT)
Temperature: degrees Celsius (C)
High frequency (RF) power: Watts (W)

**Step 1:** Pump to 5e-04 Torr, “Pump to Pressure” checked

**Step 2:** Etch Step

Tetrafluoromethane (CF₄) flow rate: 20 sccm
Pressure: 65 mT
RF Power: 150 W
Capacitor starting points: Capacitor #1: 80 %, Capacitor #2: 60 %
Time set point is hh:mm:ss (hours:minutes:seconds)*
Temperature: 15 C

**Step 3:** Pump to 5e-04 Torr, “Pump to Pressure” checked

*notes for Step 2: The time set point for the etch step should be kept below 10 minutes due to thermal issues and to avoid resist burning. If a longer time is needed for a thicker film then the system should be vented prior to running the process again.

3. Etch Characteristics

Film thickness is measured using a Filmetrics F50 optical interferometer which is equipped with a motorized stage allowing for the collection of full wafer maps. See the following link for more information about this instrument: [http://www.filmetrics.com/thicknessmeasurement/f50](http://www.filmetrics.com/thicknessmeasurement/f50)
The film being etched is PECVD SiN$_x$ deposited on 100 mm, <100> orientation, wafers that are 525 ± 25 micron thick.

Figure 1 below shows a screen capture image of a “Difference Map” from the Filmetrics software with 115 data points and a 5 mm edge exclusion. The standard Si$_3$N$_4$ – “Universal” material file supplied in the software is used for these measurements. This is data from a 3 minute etch shown as a “Difference Map” in the software that is already averaged and is displaying the etch rate in nm/min.

![Figure 1. Wafer map showing the results for a 3 minute SiN$_x$ etch using CF$_4$ showing 65 nm/min etch rate with a standard deviation of 3.36 nm and a uniformity across the wafer of ± 10.5%.](image-url)