



5-7-2016

Reactive Ion Etch (RIE) of Silicon Nitride (SiN_x) with Trifluoromethane and Oxygen (CHF₃/O₂)

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Metzler, Meredith, "Reactive Ion Etch (RIE) of Silicon Nitride (SiN_x) with Trifluoromethane and Oxygen (CHF₃/O₂)", *Tool Data*. Paper 39.

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Reactive Ion Etch (RIE) of Silicon Nitride (SiN_x) with Trifluoromethane and Oxygen (CHF₃/O₂)

Summary/Description

This report discusses the CHF₃/O₂ etch process of SiN_x using the Oxford 80 Plus RIE.

Disciplines

Nanoscience and Nanotechnology

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|  | Reactive Ion Etch (RIE) | Document No: |
| | Silicon Nitride (SiN _x) with CHF ₃ / O ₂ | Revision: |
| | Oxford 80 Plus | Author: Meredith Metzler |

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

Trifluoromethane (CHF₃) flow rate: 100 sccm

Oxygen (O₂) flow rate: 4 sccm

Pressure: 50 mT

RF Power: 150 W

Capacitor starting points: Capacitor #1: 60 %, Capacitor #2: 80 %

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>

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 Si₃N₄ – “Universal” material file supplied in the software is used for these measurements. This is data from a 3 minute etch displayed as a “difference map” in the software that is already averaged to display the etch rate in nm/min.

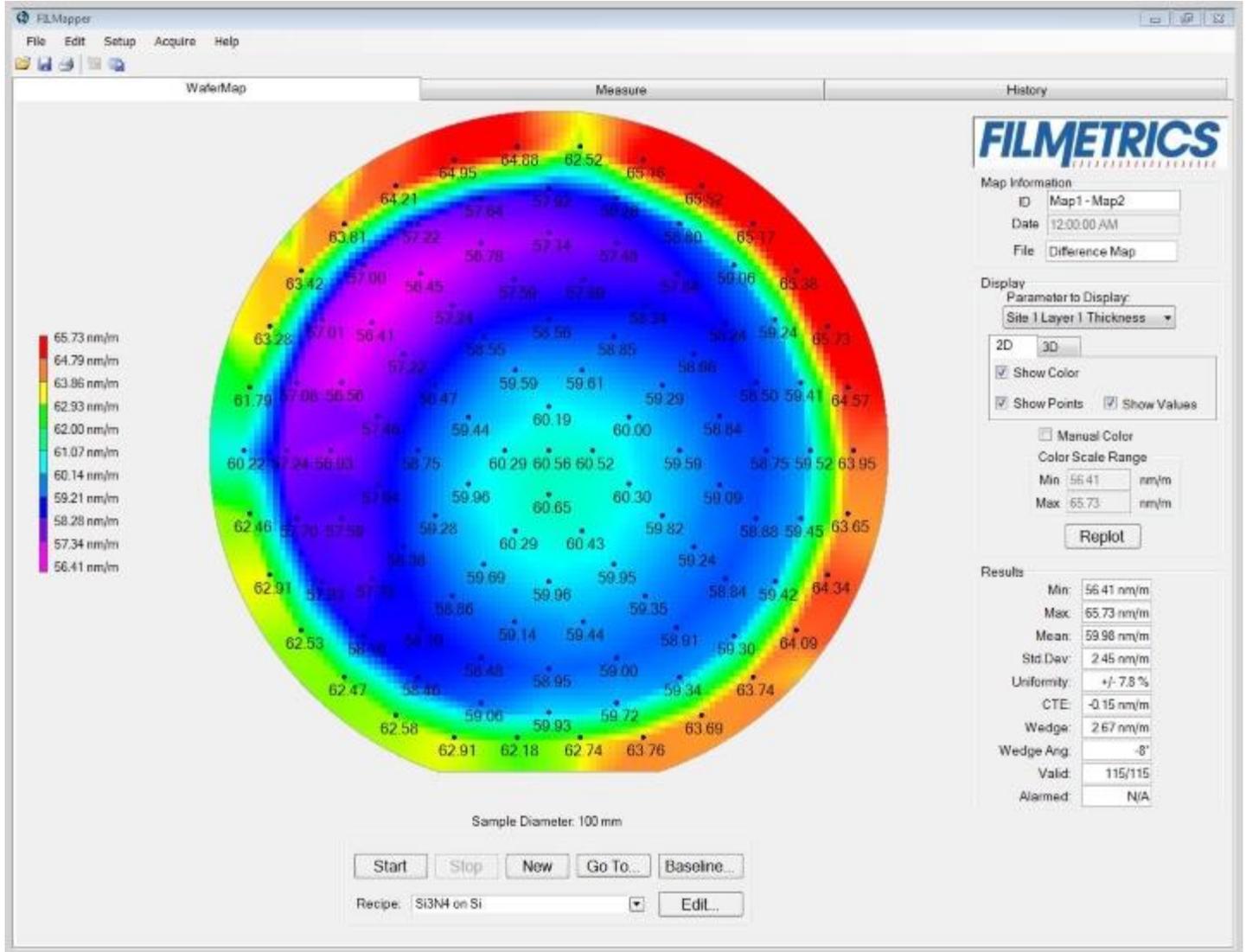


Figure 1. Wafer map showing the results for a 3 minute SiN_x etch using CHF₃ and O₂ showing 60 nm/min etch rate with a standard deviation of 2.45 nm and a uniformity across the wafer of ± 7.8%.