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5-7-2016

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Meredith Metzler
Singh Center for Nanotechnology, metzlerm@seas.upenn.edu

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Metzler, Meredith, "Reactive Ion Etch (RIE) of Silicon Nitride (SiNx) with Tetrafluoromethane (CF4)", *Tool Data.* Paper 37.
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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 (CF_4) 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

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_3N_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.

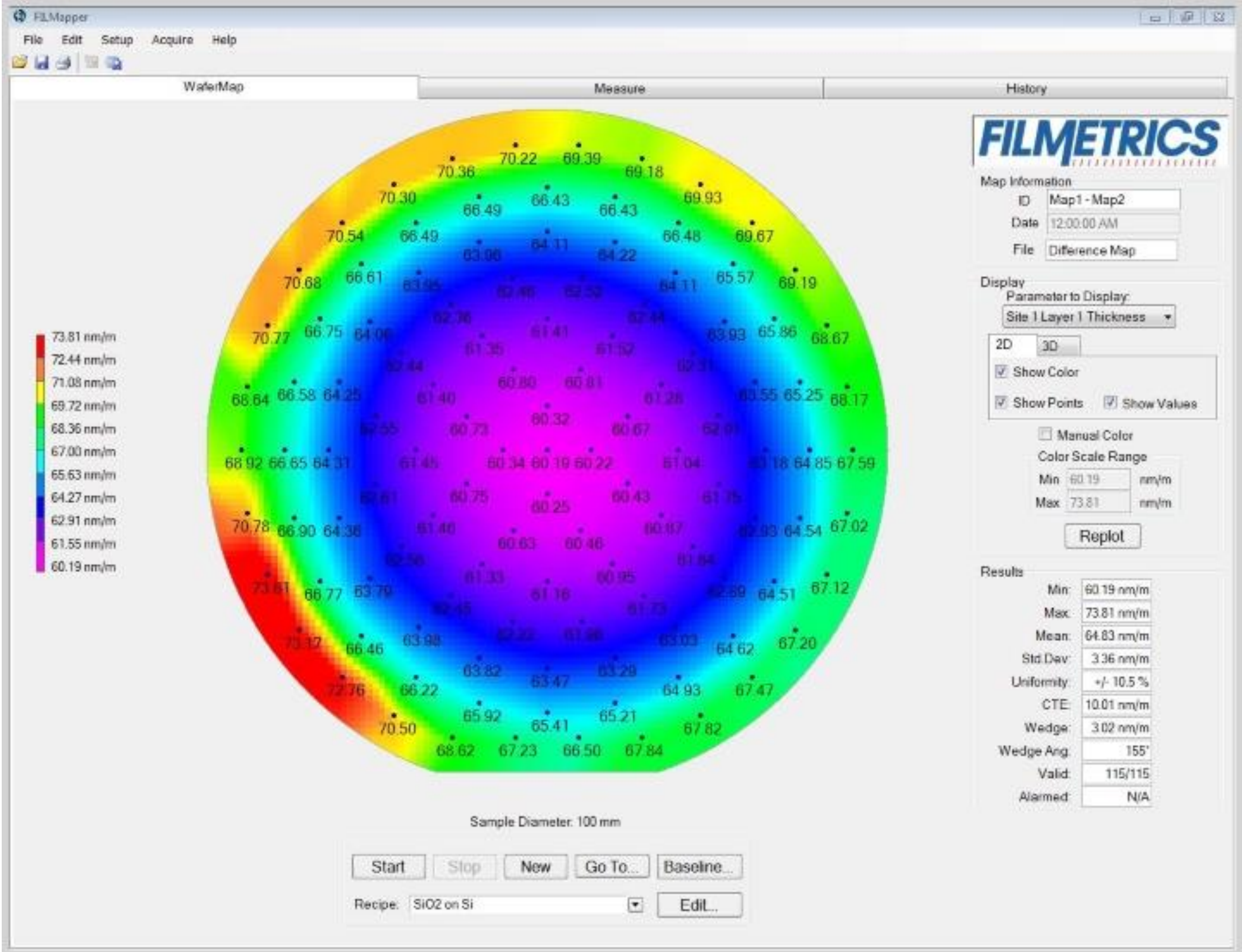

Figure 1. Wafer map showing the results for a 3 minute SiN_x etch using CF_4 showing 65 nm/min etch rate with a standard deviation of 3.36 nm and a uniformity across the wafer of ± 10.5%.