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Plasma Enhanced Chemical Vapor Deposition (PECVD) of Silicon Dioxide (SiO2)

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Plasma Enhanced Chemical Vapor Deposition (PECVD) of Silicon Dioxide (SiO2)

Summary/Description
This report discusses the deposition process of SiO2 using the Oxford System 100 PECVD.

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1. Introduction

The purpose of this document is to examine the film properties and deposition characteristics of the Oxford System 100 PECVD system.

2. Baseline Recipe

Units:

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

Step 1: 1 minute timed pump at base pressure with electrode temperature at 350 C

Step 2: Pre-heat/N2 purge with electrode temperature at 350 C, N2 flow rate at 700 sccm, Pressure set point 1400 mT [set time for full 4 inch wafer is 1 min]*

Step 3: Deposition step with electrode at 350 C

Silane (10 % SiH₄ in Helium) flow rate: 265 sccm
Nitrous Oxide (N₂O) flow rate: 1000 sccm
Nitrogen (N₂) flow rate: 500 sccm
Pressure: 1800 mT
High frequency RF power: 140 W
Low frequency LF power: 0 W
Capacitor starting points: Capacitor #1: 77 %, Capacitor #2: 26 %
Time set point is hh:mm:ss (hours:minutes:seconds)

Step 4: Pump to base pressure

*notes for Step 2: if you are processing pieces mounted on a carrier substrate, it is recommended that the time in step 2 be increased to 10 minutes to ensure temperature stabilization of your samples
3. Deposition 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

PECVD SiO₂ is deposited on 100 mm, <100> orientation, wafers that are 525 ± 25 micron thick.

Figures 1 and 2 show screen capture images from the Filmetrics software with 115 data points per wafer with a 5 mm edge exclusion. The standard SiO₂ material file supplied in the software is used for these measurements. This is data from two separate back to back 1 minute depositions.

![Filmetrics software screenshot](image)

Figure 1. Film thickness measurement for 1 minute SiO₂ deposition showing 288 nm/min deposition rate with a standard deviation of 3.26 nm and a uniformity across the wafer of ± 2.2%.
Figure 2. Film thickness measurement for a subsequent 1 minute SiO$_2$ deposition showing 287 nm/min deposition rate with a standard deviation of 3.01 nm and a uniformity across the wafer of ± 2.0%.