View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by ScholarlyCommons@Penn

University of Pennsylvania
ScholarlyCommons

Tool Data

Browse by Type

4-28-2016

Atomic Layer Deposition (ALD) film characterization

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

Yichen Lu
University of Pennsylvania, yichenlu@seas.upenn.edu

Follow this and additional works at: http://repository.upenn.edu/scn_tooldata

Metzler, Meredith and Lu, Yichen, "Atomic Layer Deposition (ALD) film characterization", *Tool Data*. Paper 33.
http://repository.upenn.edu/scn_tooldata/33

This paper is posted at ScholarlyCommons. http://repository.upenn.edu/scn_tooldata/33
For more information, please contact repository@pobox.upenn.edu.

Atomic Layer Deposition (ALD) film characterization

Summary/Description
This report shows deposition characteristics for aluminum oxide (Al_2O_3), hafnium oxide (HfO_2), and titanium dioxide (TiO_2) films deposited in the Cambridge Nanotech Savannah system. A brief study of the presence of pinholes in these films is also presented.

This technical report is available at ScholarlyCommons: http://repository.upenn.edu/scn_tooldata/33

1. Introduction

The goal of this project is to evaluate the growth rate of Al_2O_3, TiO2, and HfO_2 films deposited via atomic layer deposition (ALD) using tools available at Quattrone Nanofabrication Facility.

2. Experimental Section

Films are deposited onto 100 mm, 500 micron thick, silicon wafers using the Cambridge Nanotech S200 ALD system. All film thickness measurements are conducted with the Woollam VAS Ellipsometer before deposition to verify the native oxide thickness and again following the deposition. The Xactix is used to expose the samples to XeF_2 in an effort to accentuate any pinholes that may exist.

A. Thermal Al_2O_3 grown with Trimethylaluminum (TMA) and H_2O

- 150 °C, 100 cycles
- Growth per cycle (average): 1.25 A/cycle
- The native oxide thickness of 1.674 nm was subtracted from the measured thickness.
- Pinholes are detected with XeF_2 etching, 30 cycles, 60 sec/cycle, P_F=3 Torr, P_N=2 Torr

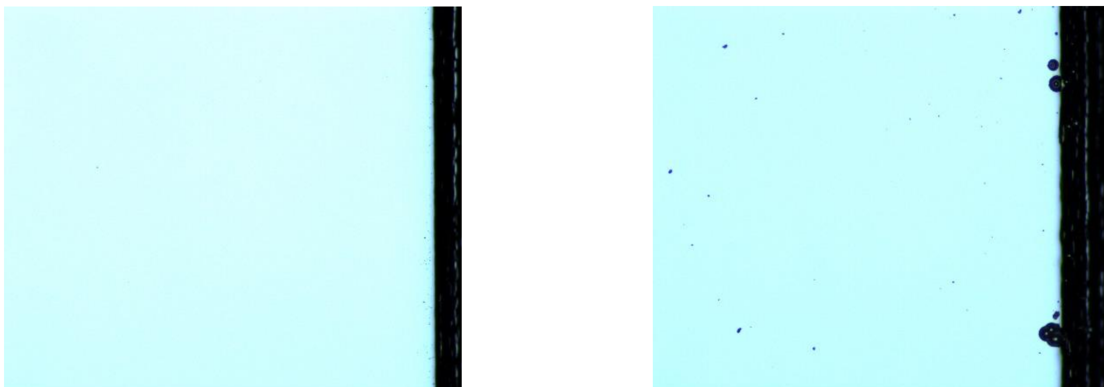

Figure 1 Microscopic photo of 10 times magnification. Left: before fluorine etching, the black strip is the wafer edge; right: after fluorine etching, a few pinholes on the edge

B. Thermal TiO_2 grown with Tetrakis(dimethylamido)titanium (TDMAT) and H_2O

- 150 °C, 150 cycles
- Growth per cycle (average): 0.435 A/cycle
- The native oxide thickness of 1.862 nm was subtracted from the measured thickness.
- Pinholes are detected with XeF_2 etching, 30 cycles, 60 sec/cycle, PF=3 Torr, PN=2 Torr

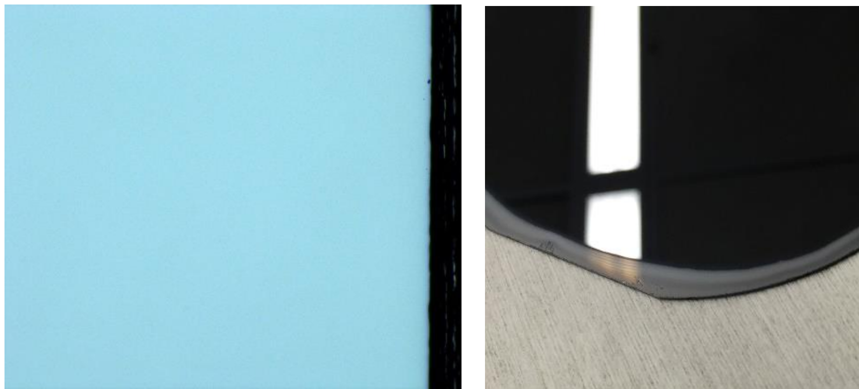

Figure 2 Left: Microscopic photo of sample before fluorine etching at 10 times magnification, the black strip is the wafer edge; right: after fluorine etching, a ring of pinholes on the edge

C. Thermal HfO_2 grown with Tetrakis(dimethylamino)hafnium (HFDMA) and H_2O

- 150 °C, 50 cycles
- Growth per cycle (average): 1.14 A/cycle
- The native oxide thickness of 1.702 nm was subtracted from the measured thickness.
- Pinholes are detected with XeF_2 etching, 30 cycles, 60 sec/cycle, PF=3 Torr, PN=2 Torr

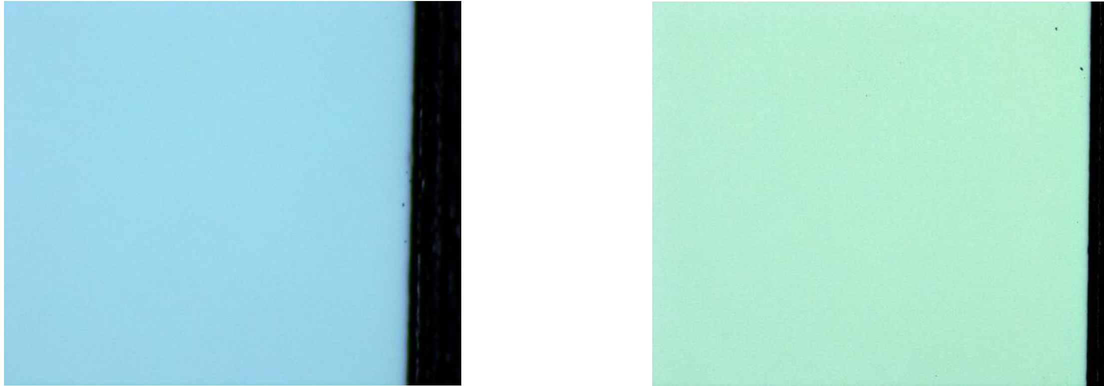

Figure 3 Microscopic photo at 10 times magnification. Left: before fluorine etching, the black strip is the wafer edge; right: after fluorine etching, a ring of pinholes on the edge