What Do You Know About Deposition? Activity

Participant Guide

Description and Estimated Time to Complete

In this activity you will demonstrate your knowledge of deposition for microsystems, by explaining at least two deposition processes, identifying the applications of microsystems in which these processes would be used and studying recent advances and improvements of these processes for microsystems fabrication.

If you have not reviewed the unit Deposition Overview for Microsystems, you should do so before completing this activity.

Estimated Time to Complete
Allow at least 1.5 hours to complete this activity.

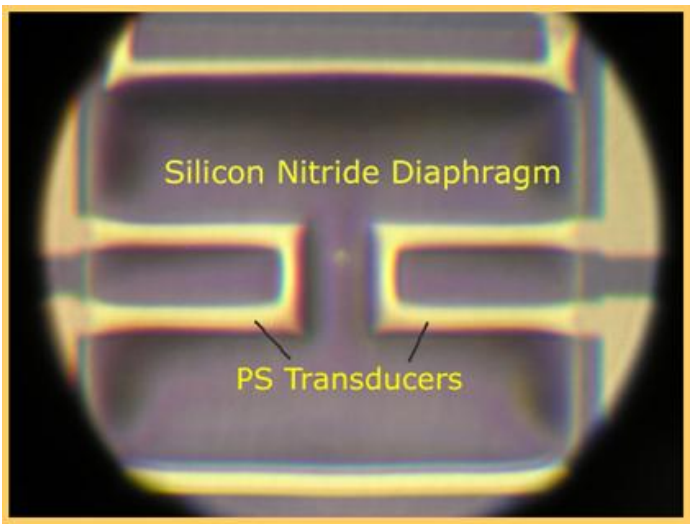
Introduction

Microsystems (or MEMS) are fabricated using many of the same processes found in the manufacture of integrated circuits. Such processes include photolithography, wet and dry etch, oxidation, diffusion, planarization, and deposition.

The deposition process, which is the focus of this activity, provides the ability to deposit a variet of thin film layers as thick as 100 micrometers or as thin as a few nanometers.[1] Such films are used for

- mechanical components (i.e., cantilevers and diaphragms),
- electrical components (i.e., insulators and conductors), and
- sensor coatings (i.e., gas sensors and biomolecular sensors).

The figure below shows a thin film of silicon nitride being used as the diaphragm for a MEMS pressure sensor.



MEMS Pressure Sensor close-up
(Electrical transducers in yellow, Silicon nitride diaphragm in gray)
[Image courtesy of the MTTC at the University of New Mexico]

Because thin films for microsystems have different thicknesses, purposes, and make-up (metals, insulators, semiconductors), different deposition processes are used. The deposition processes used for microsystems include the following:

- Spin-on film
- Thermal Oxidation (oxide growth)
- Chemical vapor deposition (CVD)
- Physical vapor deposition (PVD)
- Electroplating

Activity Objective

- Identify the type of deposition process associated with different aspects of microsystems fabrication.
- Describe three deposition processes used in microsystems fabrication.
- Discuss at recent research and improvements in at least one of these deposition processes.

Resources

SCME's Deposition Overview for Microsystems PK

Documentation

Present a written paper to your instructor that includes the questions and answers to the following questions as well the information requested on the various deposition processes.

Activity: What Do You Know About Deposition?

Answer each of the following questions and write a brief response for research requests.

1. Why is CVD the most widely used deposition method for most thin films?
2. Write the chemical formulas for the following processes and a brief explanation of each formula.
    a. Wet oxidation process
    b. Dry oxidation process
3. For each of the deposition processes below,
    a. outline the fabrication process,
    b. the types of films deposited, and
    c. at least two microsystem applications for the deposited films. These applications can be current applications as well as applications being researched.

Thermal Oxidation	a.
	b.
	c.
Chemical Vapor Deposition	a.
	b.
	c.
Evaporation	a.
	b.
	c.

4. Which deposition process(es) would be used for the following applications?

    a. conductive layer for RF switches - _____

    b. structural layer for cantilever sensors - _____

    c. sacrificial layer between the substrate and the first structural layer - _____

    d. fill in the cavity of a LIGA mold - _____

    e. a strain gauge on a microcantilever - _____

    f. a silicon nitride hard mask - _____

    g. sacrificial layer between two structural layers - _____

    h. masking layer for photolithography expose - _____

Summary

Deposition is any process that deposits a thin film of material onto a substrate. A thin film can range from greater than 100 micrometers to only a few nanometers thick. Some gate oxides used in integrated circuits are even thinner, on the order of tens of microns. Microsystems technology uses a variety of deposition processes. The type of process used depends on the thin film material, its thickness, and the structure (stochiometry) being fabricated.

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