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# Micro Pressure Sensor Process Activity

## Instructor Guide

### Notes to Instructor

The Micro Pressure Sensor Process Activity is an activity for *the MTTC Pressure Sensor Process Learning Module*. Information for each step of the process is presented in the MTTC Pressure Sensor Primary Knowledge unit and should be reviewed before completing this activity.

Units in the *MTTC Pressure Sensor Process Learning Module*:

- Knowledge Probe (KP) or pre-quiz
- MTTC Pressure Sensor Process Primary Knowledge
- MTTC Pressure Sensor Process Activity (Requires cleanroom or fabrication facility)
- A MEMS Process Model Activity
- **Micro Pressure Sensor Process Activity\***
- Surface Micromachining: Lift-Off Process Activity\*
- Bulk Micromachining: An Etch Process Activity\*
- Final Assessment

\*Kit available through [scme-nm.org](http://scme-nm.org) while supply lasts

SCME does have a kit that can be ordered through its website. However, if you don't have a kit or if none are available, you can use the random images at this end of this activity. There are 10 images that show the actual wafer after each step of the process.

## **Description and Estimated Time to Complete**

*The Manufacturing Technology Training Center (MTTC) is a process cleanroom at the University of New Mexico (UNM).*

In this activity you will demonstrate your knowledge of the MTTC Pressure Sensor Process. This activity consists of two parts:

- A matching exercise where you demonstrate your knowledge of the process order by arranging processed chips in the correct process sequence.
- A matching activity where you demonstrate your knowledge of each process step relative to the pressure sensor by matching a processed chip to its specific process step.

If you have not reviewed the *MTTC Pressure Sensor Process Primary Knowledge unit*, you should do so before completing this activity.

### Estimated Time to Complete

Allow at least 30 minutes to complete this activity.

## **Introduction**

The pressure sensor design used in the MTTC process incorporates a Wheatstone bridge configuration with a silicon nitride membrane. A thin membrane of silicon nitride ( $\text{Si}_3\text{N}_4$ ) deflects when the pressures on opposite sides of this membrane are different.

The pressure sensor fabrication process developed jointly at the University of New Mexico (UNM) and Central New Mexico Community College (CNM) consists of several steps starting with a pre-deposited silicon nitride wafer and ending with a functional set of pressure sensors.

The purpose of this activity is for you to apply your knowledge of the process steps presented in the MTTC Pressure Sensor Process Primary Knowledge unit and/or Cleanroom Activities.

## **Activity Objective**

- Given ten (10) Micro Pressure Sensor process steps, arrange them in the correct sequential order.
- Given ten (10) chips, each showing the output of one of the ten MTTC Micro Pressure Sensor process steps, match each of the ten MTTC Micro Pressure Sensor process steps to its corresponding output (chip).

## Supplies/Equipment

### Kit Supplies

- Set of 10 magnifying boxes, each one containing a sample output from each of the 10 steps of the MTTC Micro Pressure Sensor process
- Table: *MTTC Micro Pressure Sensor Process Steps* (provided in this activity)
- 1 MTTC Pressure Sensor Process Learning Module – Instructor Guide
- 1 MTTC Pressure Sensor Process Learning Module – Participant Guide

**If you do not have a kit**, use the images at the end of this activity. There are 10 random images of the fabrication process. Each image shows what the wafer looks like after a process step.

### **Documentation**

- Completed table: MTTC Pressure Sensor Process Steps.
- Post-Activity Questions / Answers

## Activity: MTTC Pressure Sensor Process Matching Activity

### Procedure:

1. *If you have a kit,*
  - a. Indicate the correct order of the process steps listed in the table MTTC Pressure Sensor Process Steps on the following page. (1 through 10 with 1 being the first step of the process).
  - b. Remove the top 10 magnifying boxes (that are not numbered) from the box set and mix them up.
  - c. Take a close look at each chip in each of the magnifying boxes.
  - d. Next to each process step written in the table, place the magnifying box that best represents the outcome of that process step.
  - e. Once you have matched the boxes to the steps, use the numbered chips in the box set to check your answers.

Note: A few of the samples look very similar. Try to match as best as you can based on the information you have been given. There are many close up photos in the MTTC Process Storyboard and the MTTC Pressure Sensor Process PK. Feel free to use these to assist you in this matching activity.

### *If you do not have a kit,*

- a. Indicate the correct order of the process steps listed in the MTTC Process Sensor Process Steps table on the following page. (1 through 10 with 1 being the first step of the process.)
  - b. Go to the images at this end of this activity. On the bottom of each image, write the number and name of the completed process step that each image shows. For example, for the image of the bare silicon wafer, write “1- silicon wafer”. (Note: A few of the images look very similar. Try to match as best as you can based on the information you have been given.)
  - c. Once you have matched all of the images to their related process steps, refer to the storyboard presentation to check your answers.
2. Answer the Post-Activity Questions.



### MTTC Pressure Sensor Process Steps

Order of Process Step (1-10)	List of Process Steps
	Backside RIE Etch
	Frontside Photolithography
	Chrome/Gold Deposition
	Backside Photolithography
	Backside Photoresist Strip
	Bare Silicon
	KOH Anisotropic Etch
	Nitride Coated Silicon
	Chrome/Gold Lift-off
	LOR Strip

### Post-Activity Questions

1. What unique criterion did you use to identify the chip that represents “frontside photolithography”?

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2. What unique criteria did you use identify the chips that represent the “backside photolithography” and the “backside RIE etch”?

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3. What is used as the membrane for the pressure sensor? (Be specific)

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4. What is the purpose of the gold layer?

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### ***Activity Answers***

#### **MTTC Micro Pressure Sensor Process Steps**

<b>Order of Process Step (1-10)</b>	<b>List of Process Steps</b>
<b><i>4</i></b>	Backside RIE Etch
<b><i>6</i></b>	Frontside Photolithography
<b><i>7</i></b>	Chrome/Gold Deposition
<b><i>3</i></b>	Backside Photolithography
<b><i>5</i></b>	Backside Photoresist Strip
<b><i>1</i></b>	Bare Silicon
<b><i>10</i></b>	KOH Anisotropic Etch
<b><i>2</i></b>	Nitride Coated Silicon
<b><i>8</i></b>	Chrome/Gold Lift-off
<b><i>9</i></b>	LOR Strip

## Post-Activity Questions/Answers

1. What unique criterion did you use to identify the chip that represents “frontside photolithography”?

*Answer: The frontside photolithography step patterns the frontside of the wafer with the Wheatstone bridge pattern.*

2. What unique criteria did you use to identify the chips that represent the “backside photolithography” and the “backside RIE etch”?

*Answer: The backside photolithography step patterns the photoresist on the backside of the wafer with open areas to expose the silicon nitride. The backside RIE etch removes the silicon nitride in the exposed areas to expose the bare silicon.*

3. What is used as the membrane for the pressure sensor? (Be specific)

*Answer: frontside silicon nitride layer*

4. What is the purpose of the gold layer?

*Answer: To create a conductive layer for the Wheatstone bridge circuit.*

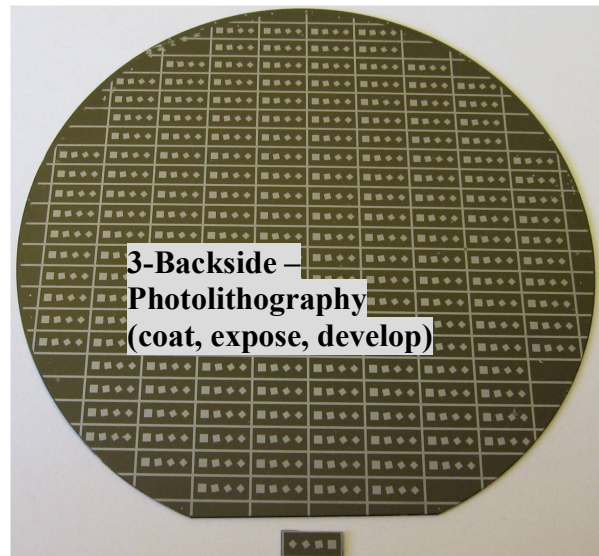
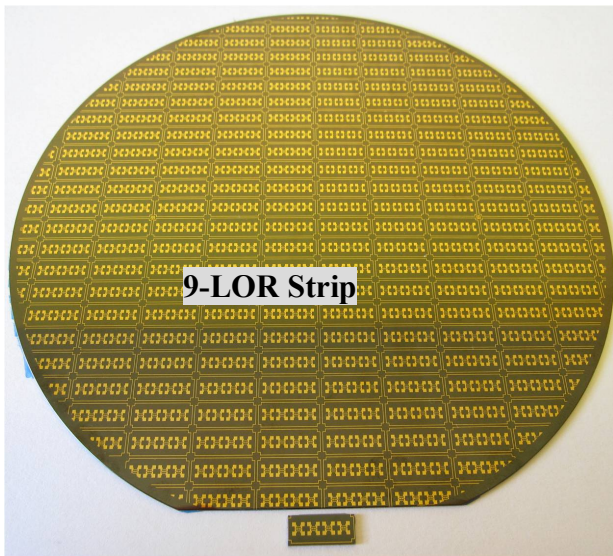
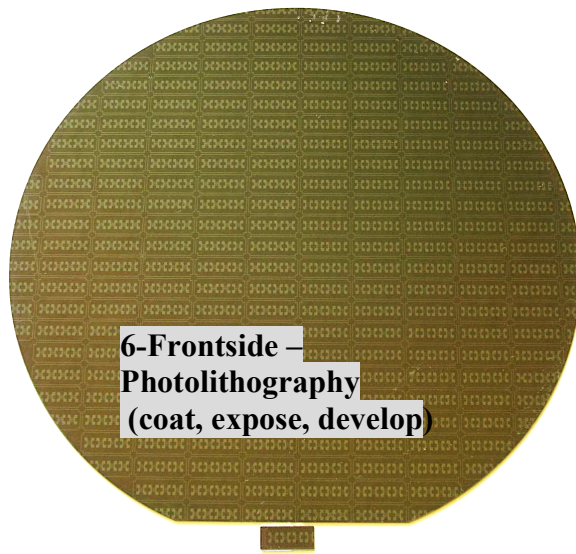
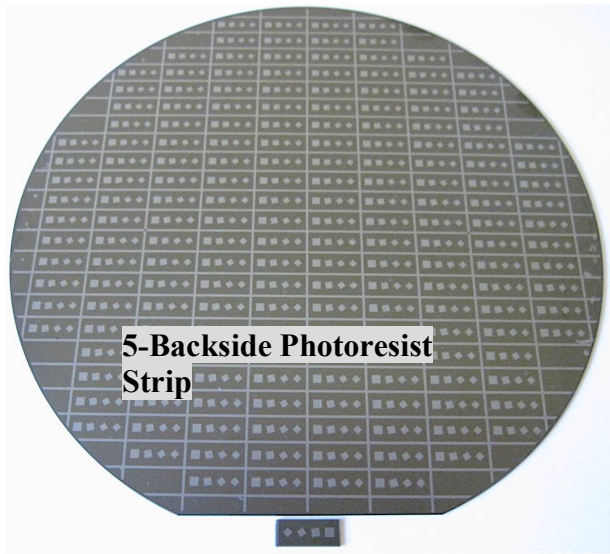
## Summary

The MTTC Micro Pressure Sensor process consists of ten (10) basic steps to create a working pressure sensor. This activity gave you the opportunity to demonstrate your knowledge of these steps by putting them in the correct sequential order, and by identifying each step visually with its corresponding outcome.

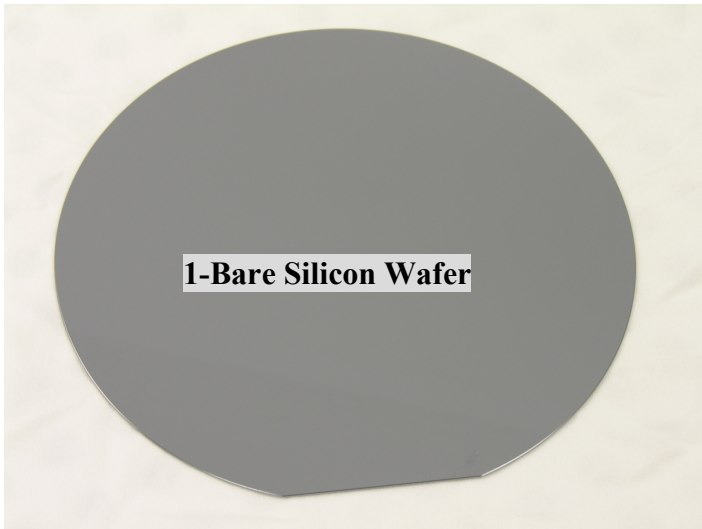
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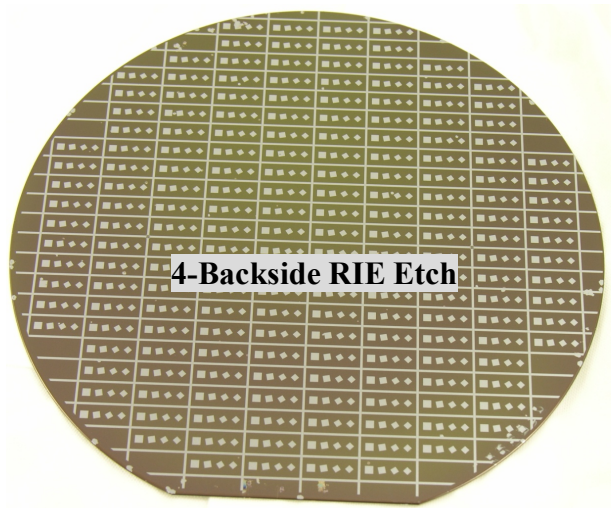
*Support for this work was provided by the National Science Foundation's Advanced Technological Education (ATE) Program through Grants. For more learning modules related to microtechnology, visit the SCME website (<http://scme-nm.org>).*



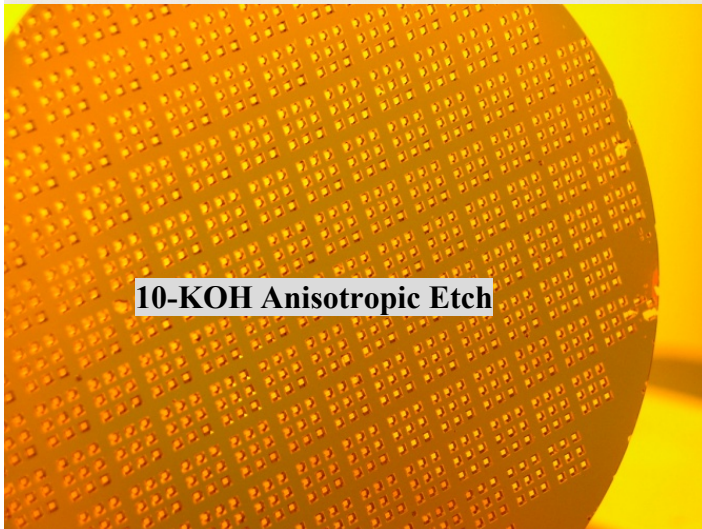




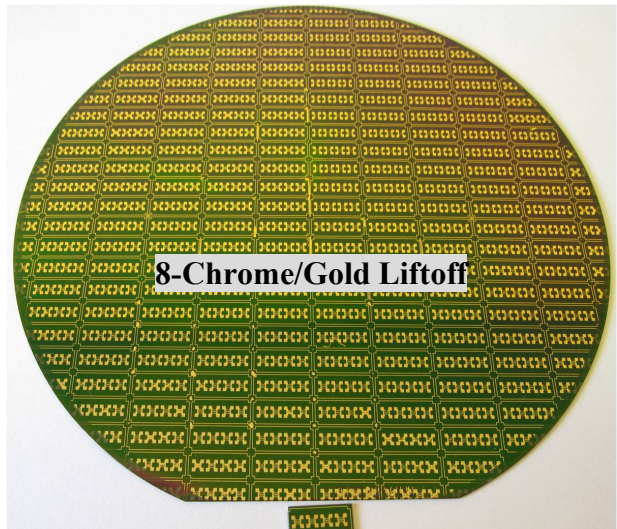
**1-Bare Silicon Wafer**



**4-Backside RIE Etch**



**10-KOH Anisotropic Etch**



**8-Chrome/Gold Liftoff**