

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

## Student Worksheet

### Part 2: Active vs. Passive Etching

#### Safety

Wear safety glasses while using vinegar, for it contains dilute amounts of acid and will burn if splashed into the eye. Scissors can be a cutting hazard, so use caution.

#### Introduction

Scientists modify a wet etching process, depending on how they need the electrical component to be sculpted. This etching occurs at the nanoscale because the chemicals remove atoms and molecules from the substrate or the material being etched (cut). In this lab, you will simulate two methods:

- The *active method* will be simulated by introducing the etching solution drop-wise on the surface of the substrate and allow it to flow off the surface carrying with it the etched particles exposing new surface on the substrate.
- The *passive method* will be simulated by submerging the substrate in the etching solution and allow the etchant solution to do work on the surface of the substrate gently without agitation.

#### Materials

- safety glasses (one per student)
- 25 in. clear tape
- 2 antacid tablets
- pair of scissors
- metric ruler
- 1 Petri dish
- 1 pipette
- 50 ml vinegar
- 2 beakers, 100 ml each
- pair of tweezers
- 10× magnifier
- clock

#### Make a Prediction

1. Which method do you predict will make the deepest and smoothest best-etched pattern?  
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2. Which method will create the larger etched channel?  
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#### Procedure

1. Tape each antacid tablet, leaving a 4 mm channel in the middle as you did in the prior lab.

#### Passive etching method:

2. Place the masked substrate with the exposed masked surface facing upward in the Petri dish. Use a pipette to transfer enough etching solution to submerge the substrate. Allow it to sit for 15 minutes. Record your observations every 5 minutes in the table on the next page.

- Use tweezers to remove the tablet and place it on a paper towel to dry. Observe etched surface with the magnifying lens, and describe the surface and the shape of the channel in the table on the next page.

Active etching method:

- Use tweezers to hold a substrate with the exposed masked surface at about a 45° angle above a compartment in the Petri dish.
- Use a pipette to drop the vinegar onto the exposed surface of the tablet at a rate of 30 drops per minute. Continue this process for 15 minutes, making observations of the etched surface every 5 minutes and recording your observations in the table below.
- After the 15 minutes, use the tweezers to remove the tablet. Place it on a paper towel and allow it to dry. Make your observations of the etched surface using the magnifying lens. Describe the surface and draw the shape of the channel in the table below.

**Record Your Observations**

	<b>Passive Etching Method</b>	<b>Active Etching Method</b>
<b>5 min</b>		
<b>10 min</b>		
<b>15 min</b>		

<p><b>Draw the final shape of the channel</b></p>		
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## Analyze the Results

1. Did the type of etching method have an effect on the edged surface?

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2. *Undercutting* is the removal of substrate material (the tablet) from underneath the mask (the tape). Which etching method—active or passive—showed the most *undercutting*? Why?

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## Draw Conclusions

3. Which etching method—active or passive—produced the best etching surface? Explain.

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4. Which etching method—active or passive—yielded the deepest channel on the substrate? Why?

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