

---

# Photolithography Overview for Microsystems

## Final Assessment

### Instructor Guide

#### Notes to Instructor

This Final Assessment (FA) contains 18 questions to assess the participants' knowledge of the photolithography processes. This FA should be given after the completion of the *Photolithography Overview Learning Module*. A comparison between this FA and the KP can be used to determine the level of participant learning as a result of this learning module.

The *Photolithography Overview for Microsystems Learning Module* consists of the following:

- Knowledge Probe or Pre-assessment
- Photolithography Overview for Microsystems
- Photolithography Terminology Activity
- Photoresist Thickness Activity
- **Final Assessment**

This Instructor Guide (IG) contains both the questions and answers for the 18 questions. The Instructor Guide learning module can be downloaded by registered members from the SCME website.

## Introduction

The purpose of this assessment is to determine your understanding of the photolithography process and how it applies to microsystems (MEMS) Fabrication.

1. Which of the following **BEST** describes the photolithography process?
  - a. The process step that transfers a pattern using UV light into an underlying layer or the substrate's bulk.
  - b. The process step that defines and transfers a pattern into a photosensitive film on the wafer's surface.
  - c. The process step that deposits a photosensitive layer of thin film on the surface of the wafer.
  - d. The process step that aligns the various layers of a microsystem device to each other in preparation for expose.

*Answer: b.*

2. Which of the following sequences **BEST** represents the ordered steps of the photolithography process?
  - a. Surface conditioning, align, coat, expose, etch
  - b. Coat, surface conditioning, align, expose, develop
  - c. Coat, expose, develop, surface conditioning, etch
  - d. Surface conditioning, coat, align, expose, bake, develop

*Answer: d.*

3. Which of the following represent the steps of surface conditioning?
  - a. Bake, apply HMDS, cool, rinse/dry
  - b. Rinse/Dry, apply HMDS, cool
  - c. Rinse/Dry, bake, apply HMDS, cool
  - d. Apply HMDS, cool, rinse/dry

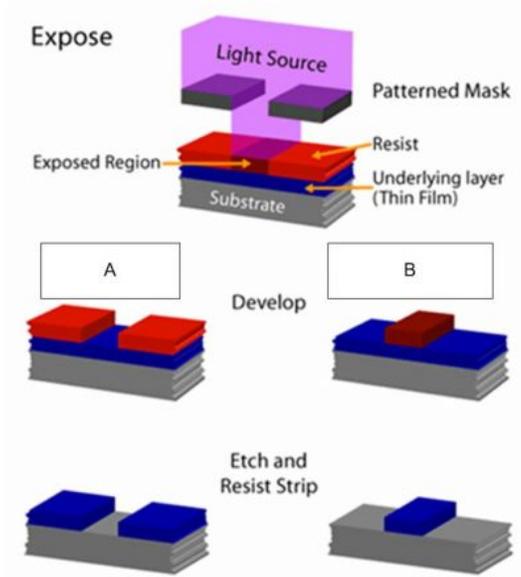
*Answer: c.*

4. What is the purpose of HMDS?
  - a. To clean and dry the wafer's surface
  - b. To create a hydrophilic and more adhesive wafer surface
  - c. To create a hydrophobic and more adhesive wafer surface
  - d. To provide a more uniform and adhesive wafer surface

*Answer: c.*

5. Which of the following is correct in reference to this graphic?
- A positive photoresist was used for “A” and a negative photoresist for “B”
  - A negative photoresist was used for “A” and a positive photoresist for “B”
  - The photoresist determines the pattern that is etched into the underlying layer
  - The exposed region is always hardened by the UV in the light source

*Answer: a*



6. Which of the following statements is NOT TRUE in reference to negative photoresist?
- UV light hardens the exposed resist
  - UV light makes the exposed resist more soluble
  - The exposed resist dissolves during develop
  - The unexposed resist hardens during the softbake

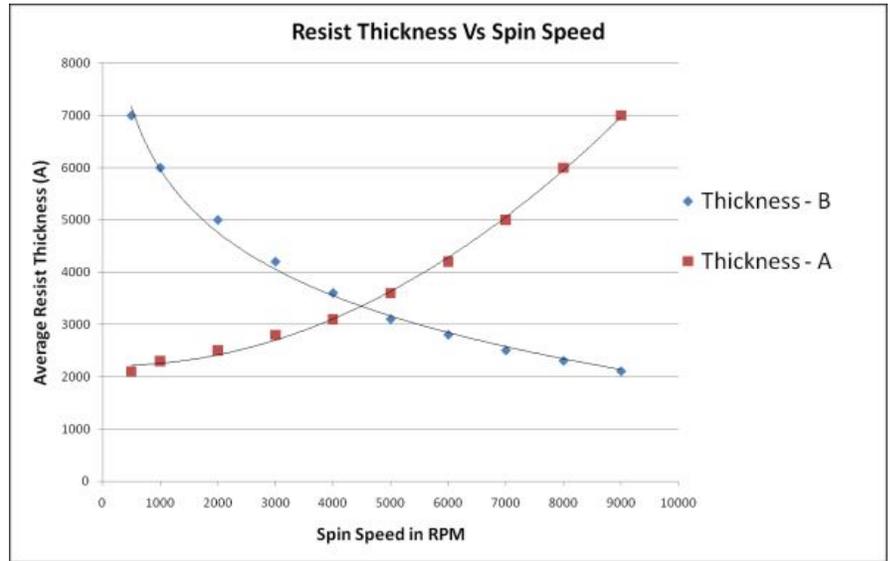
*Answer: a.*

7. Which of the following determine the final thickness of photoresist after the coat process?
- The viscosity of the resist and the amount of time that the wafer spins
  - The spin speed after deposition of resist and the amount of time that the wafer spins
  - The amount of resist applied and the amount of time that the wafer spins
  - The spin speed of the wafer after deposition of resist and the viscosity of the resist

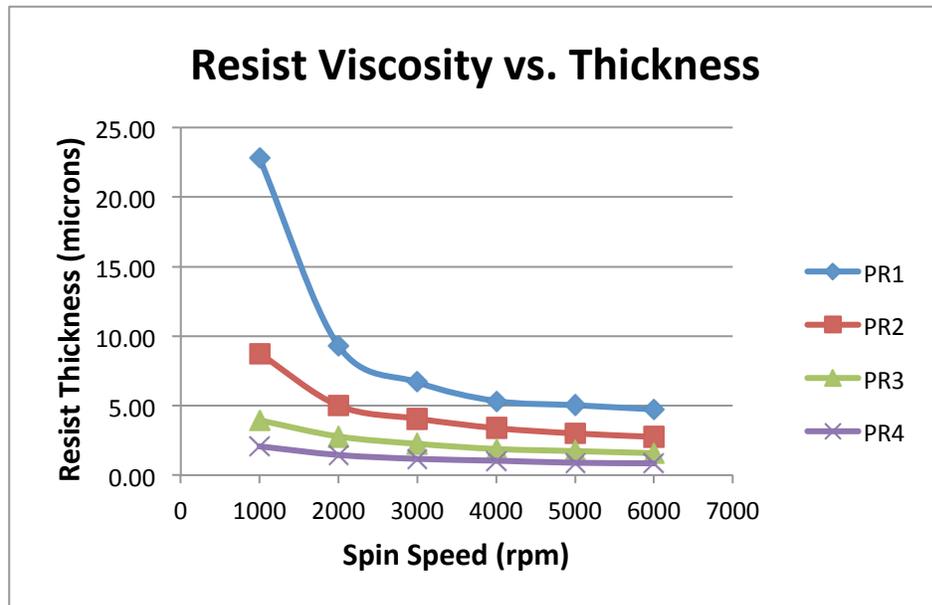
*Answer: d*

8. Which curve correctly represents a resist spin curve?
- A
  - B
  - Neither curve
  - Both curves

**Answer: b.**



9. Which of the following curves represents the photoresist with the lowest viscosity?
- PR1
  - PR2
  - PR3
  - PR4



**Answer: d. PR4**

10. A resist coat with poor uniformity could result in...
- an inaccurate alignment prior to expose
  - an inability to align the wafer for a proper expose
  - different exposures at various points on the wafer
  - non-uniform develop of resist

**Answer: c.**

11. A soft bake is used \_\_\_\_\_ the coat step and a hard bake is used \_\_\_\_\_ develop.
- Before, after
  - Before, before
  - After, before
  - After, after

**Answer: d.**

12. For the expose step, some photolithography equipment, such as steppers, use a small quartz plate that contains the pattern for just a few die or fields on a wafer. This plate is called a \_\_\_\_\_.
- Mask
  - Reticle
  - Partial mask
  - Die plate

**Answer: b**

13. What is the wavelength used to expose the photoresist?
- X-ray
  - Microwave
  - Infrared (IR)
  - Ultraviolet (UV)

**Answer: d**

14. The final test on a micro-sized accelerometer showed that the proof mass was offset from center causing the whole wafer to be rejected. Which of the following process steps is MOST likely this cause of this defect?
- Conditioning
  - Cost
  - Align
  - Expose
  - Etch

**Answer: c**

15. Which of the following could be the result of an underdeveloped resist layer?
- Misalignment of the resist pattern to the pattern in the underlying layer
  - Critical dimensions in the resist layer larger than specification
  - Too much resist left on the wafer preventing access to the underlying layer
  - Too little resist left on the wafer resulting in poor protection of underlying layer

*Answer: c.*

16. The final inspection of the photolithography process (prior to going to etch) showed that the critical dimensions and lines were poorly defined (wavy, too narrow, and in some places – totally eliminated). Which of the following is MOST LIKELY the cause of this problem?
- A hardbake that was too long or at too high of a temperature causing the resist to flow.
  - An expose that was too short causing too little resist to be removed in develop
  - An expose that was too short causing too much resist to be removed in develop
  - Too long of a develop causing too much resist to remain on the wafer

*Answer: a.*

17. After the develop step, the wafers are inspected. What are the three (3) critical parameters inspected?
- Critical dimension (line width), alignment, defects
  - Critical dimension (line width), resist thickness, alignment
  - Defects, alignment, resist thickness
  - Alignment, resist hardness, critical dimension (line width)

*Answer: a*

18. Arrange the following photolithography steps in the proper order from first (1) to last (12).

Order	Process Step
	Hard bake
	DI Rinse
	Apply HMDS
	Align
	Inspect for defects
	Initial Bake
	Coat with photoresist
	Expose
	Cool
	Develop
	Soft bake
	Nitrogen Dry

**Answer:**

<b>Order</b>	<b>Process Step</b>
11	Hard bake
9	DI Rinse
2	Apply HMDS
6	Align
12	Inspect for defects
1	Initial Bake
4	Coat with photoresist
7	Expose
3	Cool
8	Develop
5	Soft bake
10	Nitrogen Dry

*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>).*