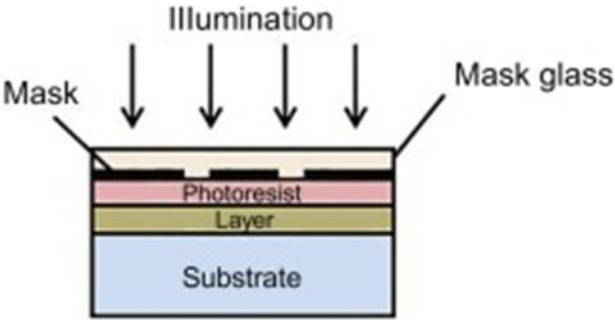
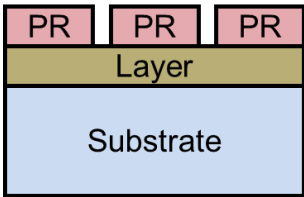
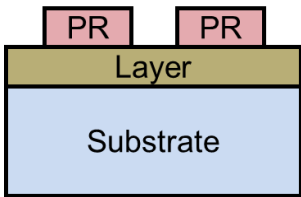
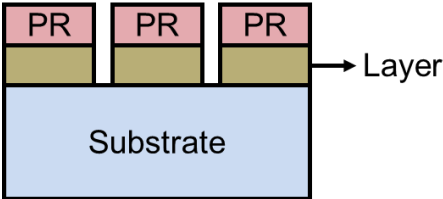
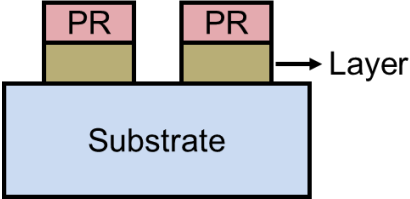
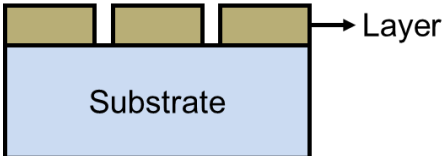
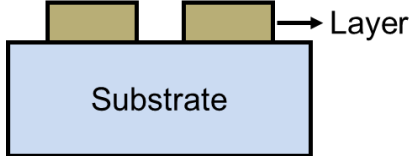


Quiz 2024-10-03

Name: _____

Student No : _____

1. According to the diagram, what will happen in the following steps (Development, Etching, and Resist removal) after the photolithography, please draw it in the table. Please also indicate which materials each layer represents. (42 points)

Illumination		
Development	Positive resist	Negative resist
		
Etching		
Resist removal		

2. Huygens's principle states that d. (9 points)

a. Waves have an ability to spread out in wave fronts as the wave passes through a small hole or around a sharp edge.

b. Two wave sources will interfere with each other both destructively and constructively so that the wave bends towards the stronger source.

c. Light rays will bend due to a change in speed when a light wave travels from one medium into another of different optical density.

d. Every point of a wave front is a point source of spherical, secondary waves. At a later time, the position of the new wave front will be that of a surface tangent to the secondary waves.

3. If we use g-line (436 nm) with $\theta = 30^\circ$ in water, assume $k_1 = 1$, what is the system resolution R? ($n_{\text{water}} = 1.3$) (15 points)

$$R = k_1 \frac{\lambda_0}{NA}$$
$$NA = n \cdot \sin\theta = 1.3 \times \sin 30^\circ = 0.65$$
$$R = k_1 \frac{\lambda}{NA} = 1 \times \frac{436 \text{ nm}}{0.65} = 670.77 \text{ nm}$$

The system resolution R is 670.77 nm.

4. a, b, d Immersion lithography is a technique used in semiconductor manufacturing to enhance the resolution and accuracy of the lithographic process. It involves using a liquid medium, typically water, between the lens and the wafer during exposure.

Which of the following **are** correct. (10 points)

- a) Have an index of refraction $n > 1$
- b) Have low optical absorption at operation wavelength.
- c) Highly reactive with photoresists and lens materials.
- d) Be uniform and non-contaminating.

5. Please write down the 3 differences between E-beam lithography and Photolithography. (24 points)

- I. E-beam lithography uses an electron beam, while photolithography uses a light beam.
- II. E-beam lithography writes patterns point-by-point, while photolithography exposes the whole plane at once.
- III. E-beam lithography operates in a vacuum, while photolithography works in the atmosphere.
- IV. E-beam lithography uses electromagnetic lenses, while photolithography uses optical lenses.
- V. E-beam lithography experiences charging effects, while photolithography does not.