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[NPTEL \(https://swayam.gov.in/explorer?ncCode=NPTEL\)](https://swayam.gov.in/explorer?ncCode=NPTEL) » [A brief introduction of Micro-Sensors \(course\)](#)
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## Unit 5 - Week 3

### Course outline

How does an NPTEL online course work?

#### Week 0

#### Week 1

#### Week 2

#### Week 3

- Si crystal structure (unit? unit=28&lesson=34)
- Si etching (unit? unit=28&lesson=35)
- KOH etching (unit? unit=28&lesson=36)
- TMAH etching (unit? unit=28&lesson=37)
- Deposition and Lithography (unit? unit=28&lesson=38)
- Lithography (unit?)

## Assignment 3

The due date for submitting this assignment has passed. **Due on 2020-02-19, 23:59 IST.**  
As per our records you have not submitted this assignment.

1) Choose the incorrect statement regarding silicon crystal structure from below: **2 points**

- Silicon has Zinc blend structure
- In 100 family of planes two dangling bonds and two bonds connected to bulk are present per atom
- In 110 family of planes two covalent bonds are formed with atoms on the plane and one bond is made with atoms below the plane
- The 111 plane intersects x-axis at  $x=a$ , y-axis at  $y=a$  and the plane is parallel to z-axis
- The order of binding strength of different planes of silicon is  $111 > 110 > 100$

No, the answer is incorrect.

Score: 0

Accepted Answers:

*The 111 plane intersects x-axis at  $x=a$ , y-axis at  $y=a$  and the plane is parallel to z-axis*

*The order of binding strength of different planes of silicon is  $111 > 110 > 100$*

2) What will be the angle (in degrees) between 121 and 110 plane? **2 points**

- 54.7
- 75
- 30
- 45

No, the answer is incorrect.

Score: 0

Accepted Answers:

30

3) A plane make intercepts 5, 4 and 6 at x-, y- and z- axes respectively. Which of the following will be the equation of the mentioned plane? **1 point**

unit=28&lesson=39)

Quiz :

**Assignment 3  
(assessment?  
name=51)**

A brief

introduction of  
Micro-Sensors:

Week 3

Feedback form  
(unit?

unit=28&lesson=53)

Week 3 Lecture

Materials (unit?

unit=28&lesson=56)

Assignment 3

Solutions (unit?

unit=28&lesson=60)

**Week 4**

**Week 5**

**Week 6**

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$12x+15y+10z = 60$

$12x+15y+10z = 1$

$x/5+y/4+z/6 = 0$

$5x+4y+6z=1$

$5/x + 4/y + 6/z =1$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$12x+15y+10z = 60$

4) Which of the following is isotropic etchant? **1 point**

30% KOH solution

HNA etchant

EDP at  $115^0$  C

TMAH at  $70^0$  C to  $90^0$  C

No, the answer is incorrect.

Score: 0

Accepted Answers:

*HNA etchant*

5) Which of the following methods cannot control the etching rate of silicon substrate? **1 point**

Concentration of KOH solution

Temperature at which etching takes place

Thickness of the masking layer

Boron doping concentration of Si substrate

No, the answer is incorrect.

Score: 0

Accepted Answers:

*Thickness of the masking layer*

6) Choose the correct statement : **1 point**

i. Boron doping concentration at certain regions can be increased so that, those regions will act as mask and will not be etched away and structures like diaphragm and cantilevers could be obtained

ii. There is no etching along  $\langle 111 \rangle$  direction of a single crystal Si wafer using KOH solution

Only i is correct

Only ii is correct

Both i and ii are correct

Both i and ii are wrong

No, the answer is incorrect.

Score: 0

Accepted Answers:

*Only i is correct*

7) A  $\langle 100 \rangle$  silicon wafer is  $500 \mu\text{m}$  thick. A mask consists of rectangular window of unknown size. The sides of the window are parallel to  $\langle 110 \rangle$ . After wafer etching a hole size of  $50 \mu\text{m} \times 80 \mu\text{m}$  is formed on the other side of the wafer ( $50 \mu\text{m}$  along X axis, and  $80 \mu\text{m}$  along Y axis). What will be the size of the mask window, along X axis? The undercut rate is negligible. (inward slope =  $54.74^0$ )

\_\_\_\_\_  $\mu\text{m}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 740,770

**2 points**

8) With the data given in question number 7, determine the size of the mask window, along Y axis.

\_\_\_\_\_  $\mu\text{m}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 777,800

**1 point**

9) Thickness of a  $\langle 100 \rangle$  silicon wafer is  $410 \mu\text{m}$ . A square window of  $1000 \mu\text{m}$  size is opened in the oxide on the front surface of the wafer with the mask edge aligned parallel to the  $\langle 110 \rangle$  direction. The oxide on the back of the wafer is completely etched. This wafer is subjected to anisotropic etchant whose etch rate along the  $\langle 100 \rangle$  direction is  $50 \mu\text{m}/\text{hour}$ . Due to this etching process for duration 4 hours, a square diaphragm of thickness  $t \mu\text{m}$  and side  $x \mu\text{m}$  has been created. Determine the diaphragm thickness  $t$  in  $\mu\text{m}$

\_\_\_\_\_  $\mu\text{m}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Numeric) 10

**2 points**

10) With the data given in question number 9, determine diaphragm side  $x$  in  $\mu\text{m}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 700,730

**2 points**

11) need to deposit a thin copper layer on my silicon sample. Which of the following method(s) could be used for this? **2 points**

- Thermal evaporation
- Dip coating
- Sputtering
- Spin coating
- Spray painting

No, the answer is incorrect.

Score: 0

Accepted Answers:

*Thermal evaporation*

*Sputtering*

12) What resolution (in pm) could be achieved, theoretically, by e-beam lithography while applying a 20 KV input?

\_\_\_\_\_ pm

No, the answer is incorrect.

Score: 0

Accepted Answers:

(Type: Range) 28,34

**3 points**