Morphological box "Pressure sensor"

Subtask		Solutions for subtasks 1	2	3	4	5
Measurement Principal	A	Piezoelectric X	Piezo resistive	capacitive	optical Pressure	Inductive
Signal conversion	B	Mech. deformation to electric voltage	wheatstone bridge.	capacitive discharge	optical LED camera	change in inductance.
Signal Proces.	C	Shunt calibration	Amplification	Filter	comparision	Display unit
Pressure sensor type	D	Absolute	Differential	Relative	Gauge	Vaccum pressure

Name: Manish kumar

Student ID: 4847552

MEMS laboratory class

Institut für Mikrotechnik

Manish.

Job no.	Pressure sensor	Date:
Completed by:		Sheet no.:

List of specifications

Structure	No.	Label	Values, data	Type	Source, comments
		Maximum pressure	1.2 bar		Mandatory
		Pressure Range	0-1 bar		Need but not M.
		Accuracy	±50 bar		Mandatory
		Pressure level	Quasi-static		Need but Not Mandatory
		Output voltage	0-1 V	Mandatory.	Need but Not
		Supply voltage	±12 V		Need but Not
		Annual Demand	2,000,00 units		Data right- acceptable.
		Cost	Minimum		
		Life time of Product	2-3 years		Need.
		After sale service of Product	2-3 years till its validity		Need.

Name: Manish kumar	MEMS laboratory class	Institut für Mikrotechnik
Student ID: 4847551		

Task ① see sample Solution
Manish U847552

Manish kumar

① $Si + 2OH^- + 2H_2O \rightarrow SiO_2(OH)_2^{2-} + 2H_2$

KOH = 40%

Density of KOH = $2.12\ g/cm^3$

molar mass of KOH = $56.11\ \frac{g}{mol}$

$$\text{molarity} = \frac{\% \times \text{density}}{\text{molar mass}} = \frac{0.4 \times 2.12\ \frac{g}{cm^3}}{56.11\ \frac{g}{mol}} = 0.0151\ \frac{mol}{cm^3}$$

$$= 15.11\ \frac{mol}{Liter}$$

① better/improved volume calculation see extra page

↳ Volume of membrane = $(Width)^2 \times$ thickness

$$= (4000 \times 10^{-6})^2 \times ((450-25) \times 10^{-6})$$

$$\text{Volume} = 6.8 \times 10^{-9}\ m^3 \Rightarrow 6.8 \times 10^{-3}\ mL$$

②

$$n = \frac{m}{M}$$

$$n(Si) = \frac{\text{Volume} \times \rho\ \text{silicon}}{\text{Molar Mass of silicon}}$$ ✓

$\rho_{silicon}$

$$= \frac{6.8 \times 10^{-9}\ mL \times 2.3296\ \frac{g}{mL}}{28.0855\ \frac{g}{mol}} = 5.617 \times 10^{-4}\ mol$$

~~[illegible]~~ mol

$4.87 \cdot 10^{-4}$ mol

$n(H_2) = 2 \times n(Si)$ ✓

$= 2 \times 5.617 \times 10^{-4}$

$= 1.1234 \times 10^{-3}$ mol

$9.74 \cdot 10^{-4}$ mol

① → $pV = nRT \rightarrow V = \frac{nRT}{p}$

V_{H_2} → $V = V_{m,0} \cdot n = 22.414\ \frac{L}{mol} \cdot n = 0.218\ L$

volume of water

$PV = nRT$ ← just for gases, water is a fluid

$$V = \frac{nRT}{P}$$

$R = \frac{R.M.}{M.M}$

$$V = \frac{8.314 \times 293 \times 1.1234 \times 10^{-3}}{101,325}$$

$V = 0.0271$

$V = \frac{m}{\rho} = \frac{M \cdot n}{\rho}$

At 20°C – 30°C

$V = 0.0176\ mL$

molarity

$\frac{g}{cm^3}$

$$\frac{0.4 \times 2.12}{56.11} = 0.01511$$

99.84

30.06.17 DG

Scanned by CamScanner

Manish
4847552

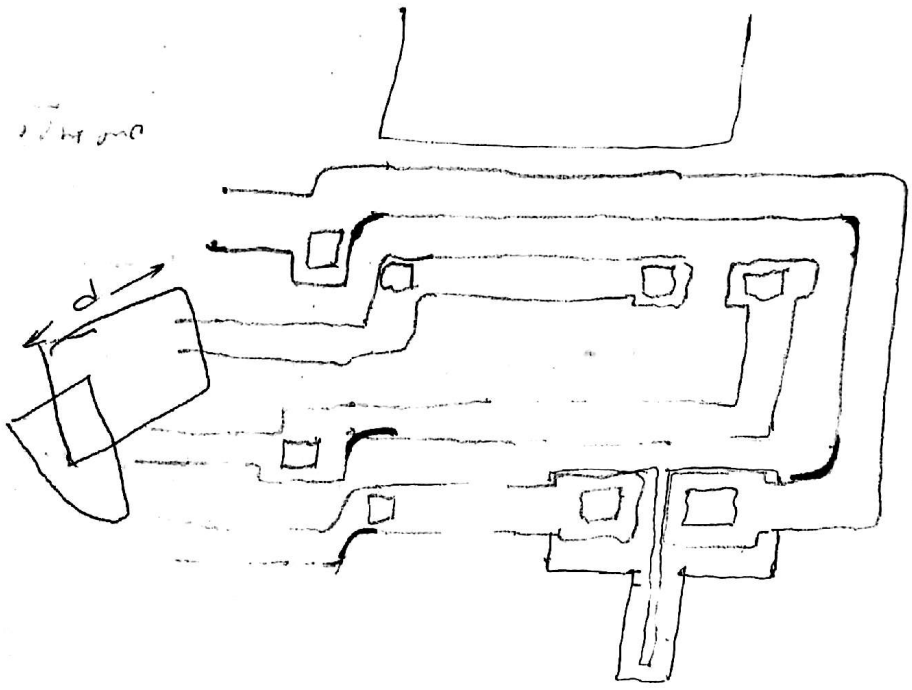
(3) $$m(KOH) = \frac{w(KOH) \cdot m(H_2O)}{(1 - w(KOH))}$$

$$= \frac{0.40 \times 2000\,g}{(1 - 0.40)} = 1333.3\,g$$ ✓

$$\eta(KOH) = \frac{\text{mass of KOH}}{\text{M.M of KOH}} = \frac{1333.33}{56.11} = 23.76\ \text{mol}$$

(4) Evaporation of H_2O might play a role in changing KOH concentration. ✓

(5) It is important to know the shift b/w mask and wafer to prevent undercetching of the planned structures. ✓



26.06.17

Manish
u847551 30.06.12 24.

Etch rate = $\frac{\Delta d}{\text{time}}$ ✓ $\left[\frac{\mu m}{min}\right]$

(7) time = $\frac{\text{thickness}}{\text{Rate of Etch}}$ → d = mass thickness − membrane thickness

450 / 450−25 / 500 μm

		15 μm	25 μm	35 μm
$t\langle 110 \rangle = \frac{425 \mu m}{100.64 \mu m/h}$	$\frac{500}{100.64}$	4.3233 h ✓	4.2246 h	4.12 h ✓
$t\langle 100 \rangle = \frac{425 \mu m}{42.85 \mu m/h}$	$\frac{500}{42.85}$		9.91 h	→ in 100 also ok, since it was not clearly in task description
$t\langle 111 \rangle = \frac{425 \mu m}{1.62 \mu m/h}$	$\frac{500}{1.62 \mu m/h}$			

110 would be correct direction for etching

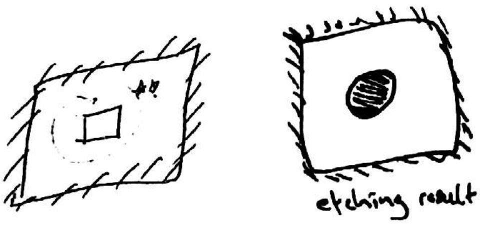
~~other direct~~

(8) In 110 it equal to $9.91\,h \times 100.64 \frac{\mu m}{h} = 997.78 \mu m$

~~why 9.91~~ h. be

in 111 it equal to $9.91\,h \times 1.62 = 16.05 \mu m$

in 100 it equal to $9.91\,h \times 42.85 = 424.64 \mu m$

(9) 

→ Mass is glass with chrome on it

(10) Table 2.7 first figure

$$d = \frac{V_{x} e d \sqrt{2}}{\sin(\alpha + 45)} = \frac{1.5 \times 500 \times \sqrt{2}}{\sin(90-57.68)+45}$$ unit? = $\frac{1060.66}{0.9743}$ = 1088.55

Scanned by CamScanner