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Shapes Ink to Shape

SMI - L-10

Thursday, February 17, 2022 2:27 PM

Piezoresistor → very thin film

(Piezo-resistive sensor)

1. Device - Aspects
2. Fabrication - Aspects

deform

Silicon → SiO_2

Wafer ← (Silica)

Strepp
Strain
fluid flow
Inertial
Shear stress

} deform

Silicon based Piezo-resistor

high change in the resistance

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Wafer ← (Silica)

Stress
Strain
fluid flow
Inertial
Shear stress

} deform

high change in the resistance

Silicon based Piezo-resistor

acceleration, force, Torque, strain, flow, viscosity, aerodynamics, to blood flow, chemical reactive

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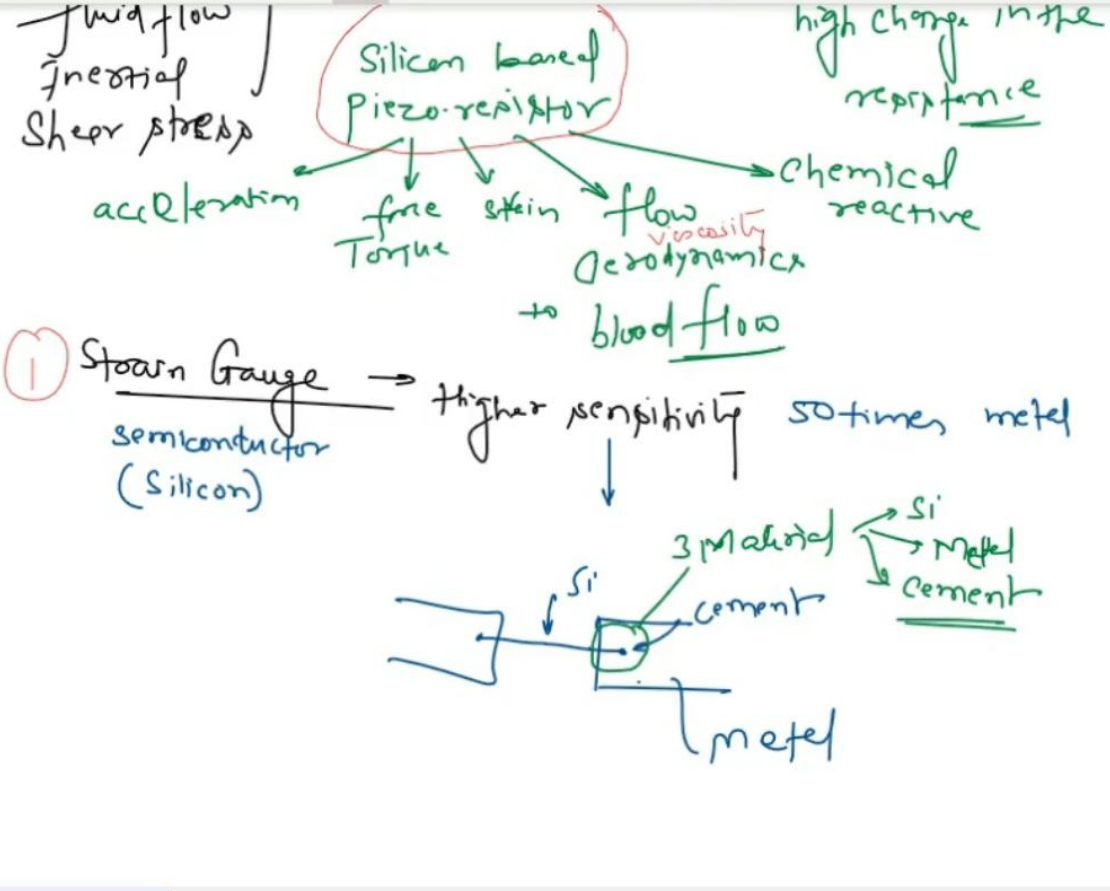

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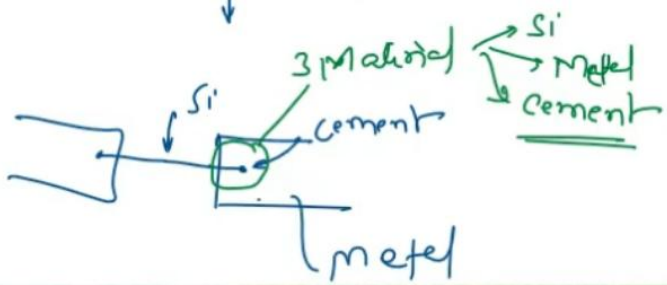
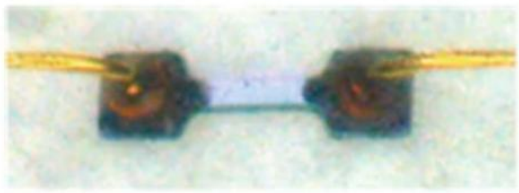
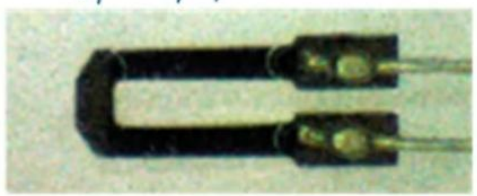
(1) Strain Gauge → higher sensitivity 50 times metal

semiconductor (Silicon)







(2) Pressure sensor

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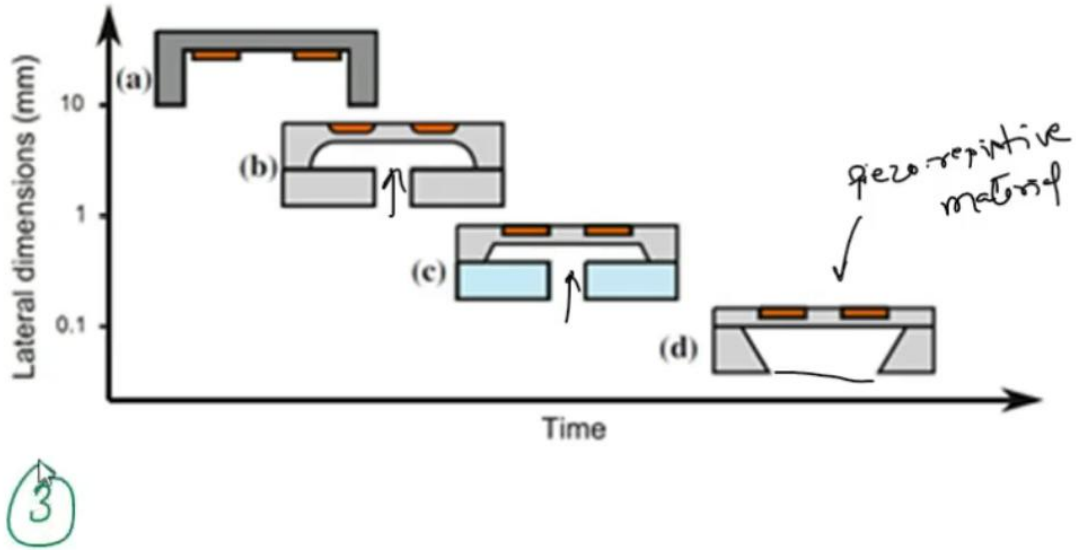
(2) Pressure sensor



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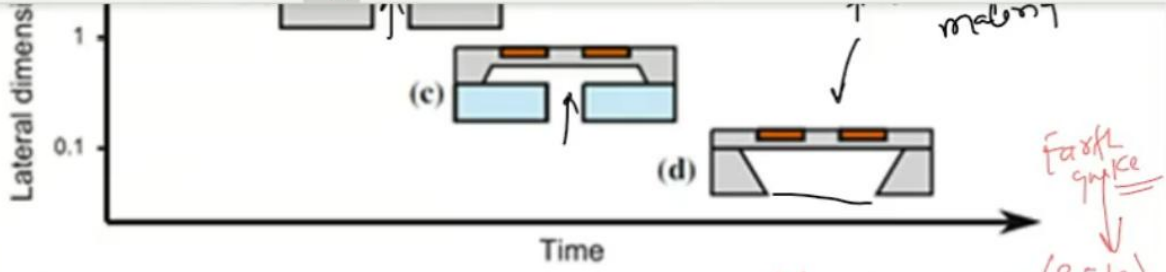

3 Cantilever Beams

vibration amplitude freqn time

deformation load cell

(3-5 Hz) cyclic

Strain gauge Material Low frequency

defor Accelerometer

strain → stress → periodicity → freq

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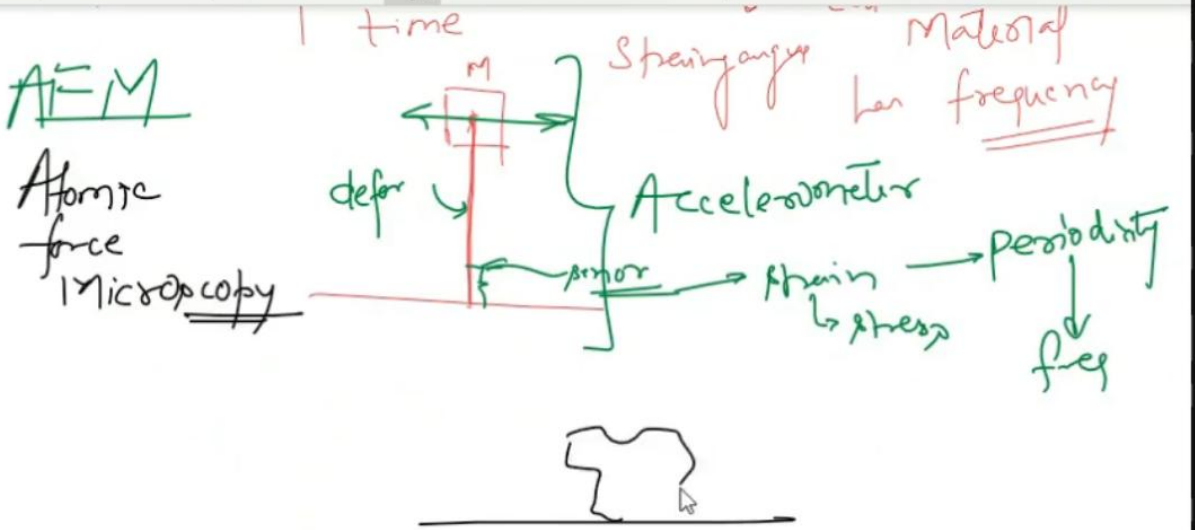

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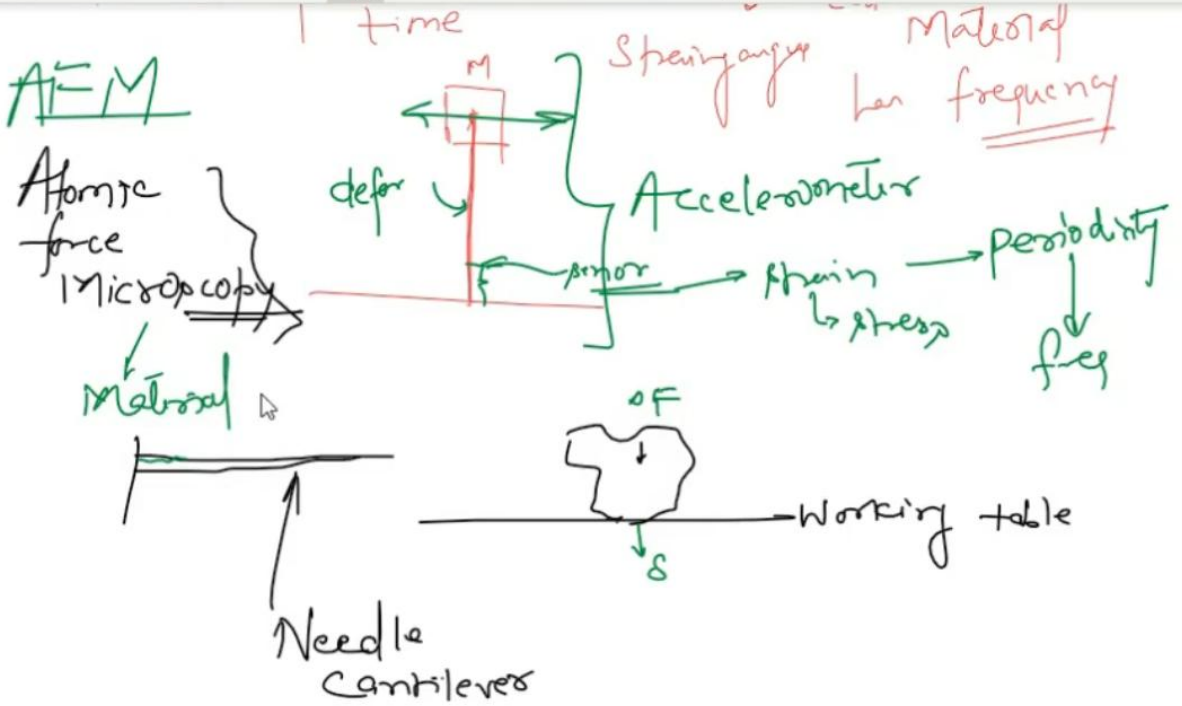

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Working table

δ

Needle Cantilever Metal

Silicon wafers

bi

brittle

fragile

Half W.B

m

accelerometer

vibration

Response speed

change in velo

D

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Shapes Ink to Shape

fragile

accelerometer → vibration
→ Response speed
→ change in velo

Gyroscopes

Automotive, military applications
Guiding & Sensing, Stimy,

JANME JAYSINGH CHAUHAN

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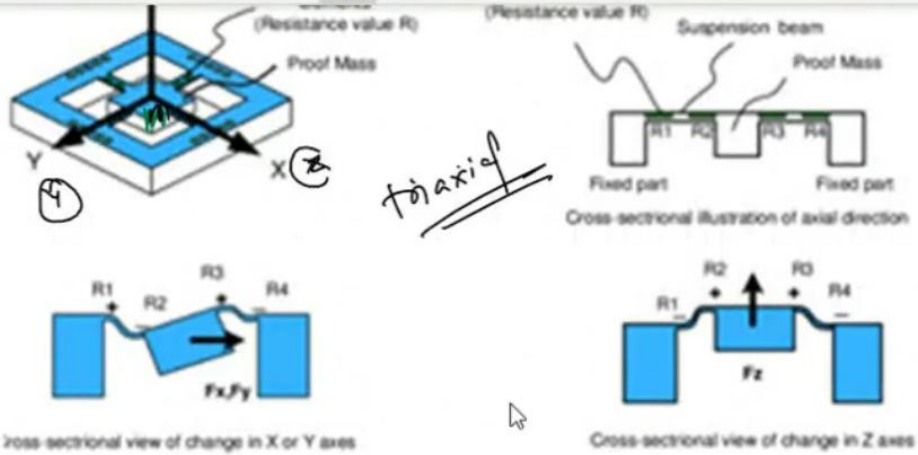

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Shapes Ink to Shape

Febrication Aspect (Doping) → dopant concentration

- Ion implantation
- Diffusion
- Epitaxy

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Shapes Ink to Shape

Febrication Aspect (Doping) → dopant concentration

- Ion implantation
- Diffusion
- Epitaxy

Silicon wafer → Boron, Arsenic, Phosphorus

[Silicon Wafer] ← dope

→ piezoresistor

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Shapes Ink to Shape

Febrication Aspect (Doping) → dopant concentration

- Ion implantation → single piece
- Diffusion → batch process
- Epitaxy → HCl → Si

Silicon wafer

- Boron
- Arsenic
- Phosphorus

[Silicon Wafer] ← dope

→ piezoresistor

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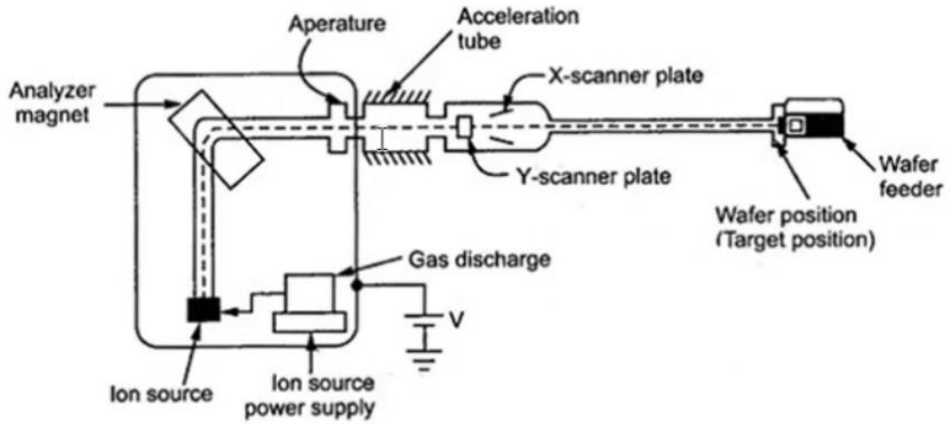
Shapes Ink to Shape

Wafer

piezoreplator



Schematic diagram of typical ion-implanter

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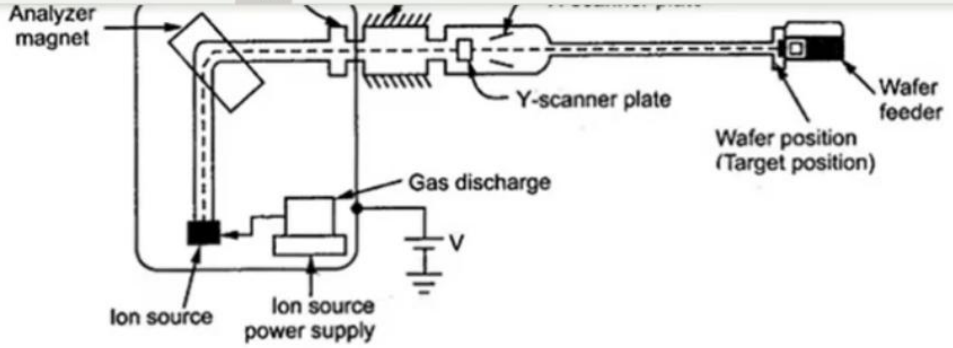

Schematic diagram of typical ion-implanter

Table 4.1 Summary of the most common piezoresistor fabrication techniques: predeposition/diffusion, ion implantation and epitaxy

	Predeposition	Ion implantation	Epitaxy
Temperature (°C)	750–1100	750–1100	600–1100
Pressure	Atmospheric	High vacuum	Low vacuum
Throughput	High	High	Low
Lattice damage	Minimal	Substantial	Minimal
Concentration (cm^{-3})	10^{20}–10^{21}	10^{16}–10^{20}	10^{16}–10^{20}
Min. t_j (nm)	<100	>500	<100
Masking materials	Hard mask	Hard/Soft mask	Hard mask
Profile modeling	Less complex	More complex	Less complex