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Shapes Ink to Shape

Fx,Fy

Fz

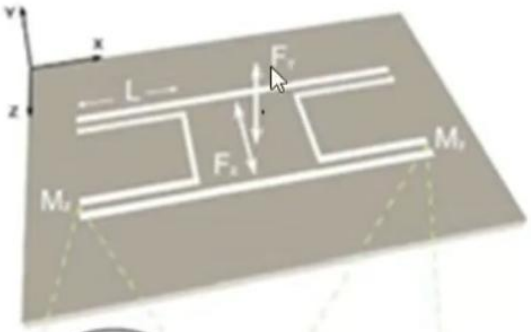
Cross-sectional view of change in X or Y axes

Cross-sectional view of change in Z axes

Shear stress

P

P



Top Implant

Side Implant

D

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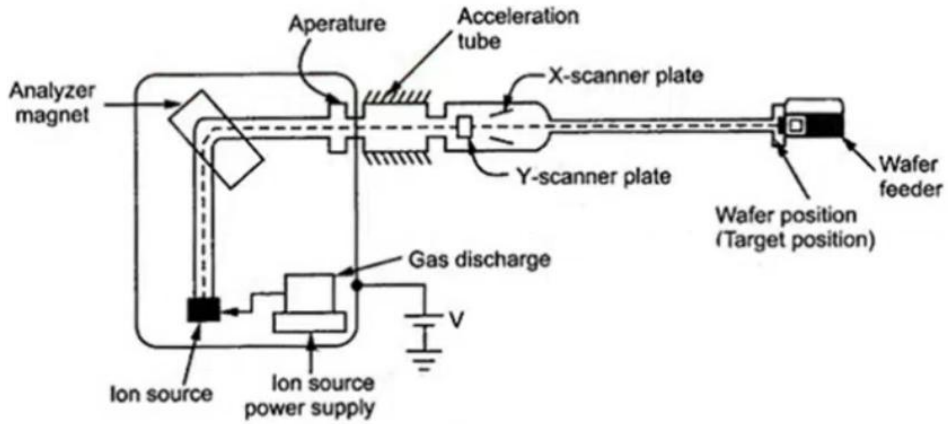
Wafer

Piezoreplator



Schematic diagram of typical ion-implanter

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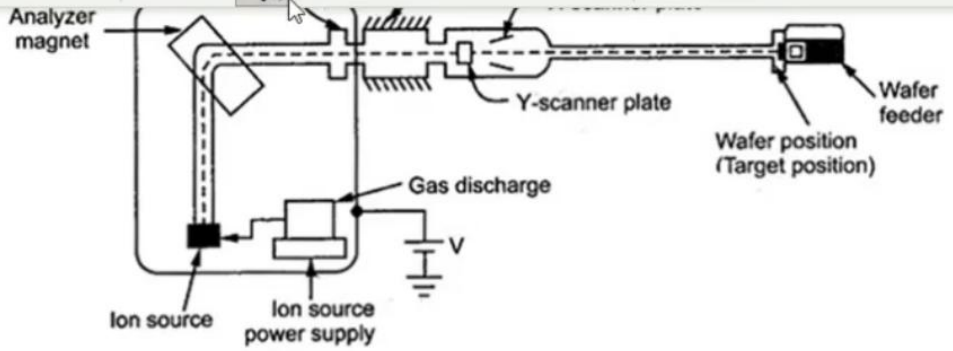

Schematic diagram of typical ion-implanter

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

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Magneto-striction

Ferromagnetic material

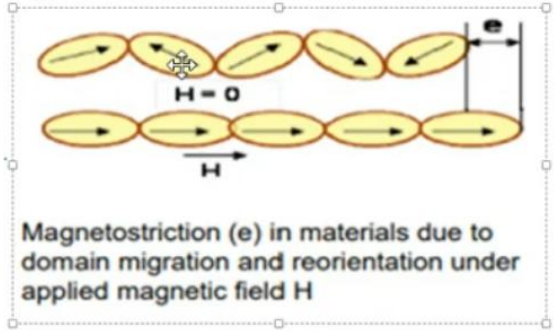
Magnetic field intensity (H)

Magenetostriction

undergo some change in its shape

→ magnetic moment

→ domain



Magnetostriction (e) in materials due to domain migration and reorientation under applied magnetic field H

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Iron

change in ΔH

Sensor applications

Reciprocal effect

Magnetic Energy

Transformed

Mechanical energy

ΔL → elastic

Material	Magnetostriction ($\times 10^{-6}$)	Curie Temp (K)
Fe	20	633
Ni	-40	1043
Co	-60	350
NiCo	186	600
$TbFe_2$	1750	703
Terfenol-D ($Tb_{0.3}Dy_{0.7}Fe_{1.9}$)	2000	380
Galfenol	300	600

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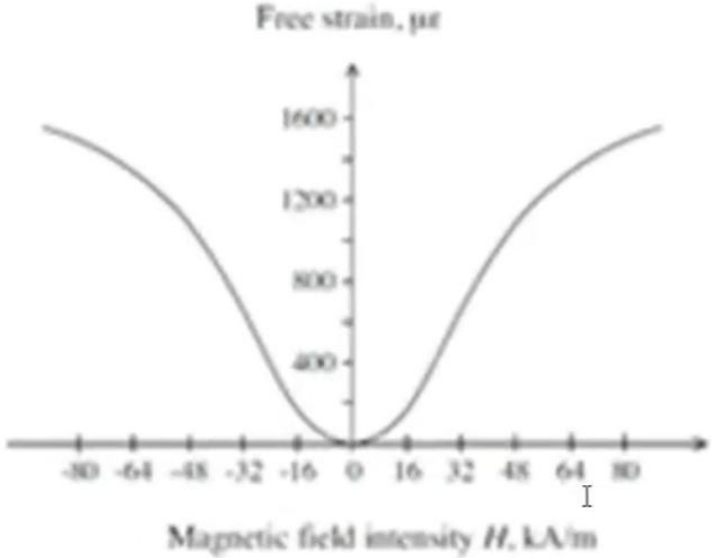
Sensor



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VIEW	Digital Signal Processing Lab	75	100.00	AB
VIEW	Introduction to Data Science	72	100.00	AB
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Matteuci Effect → Application of torque → Change in magnetization

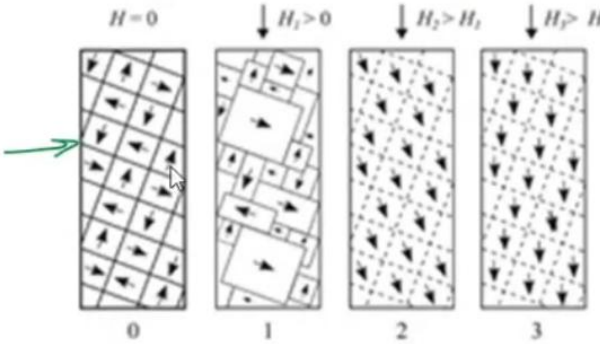
sensor

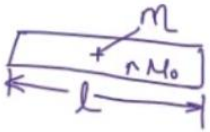
Mechanism

Ferromagnetic material

iron

magnetic moments





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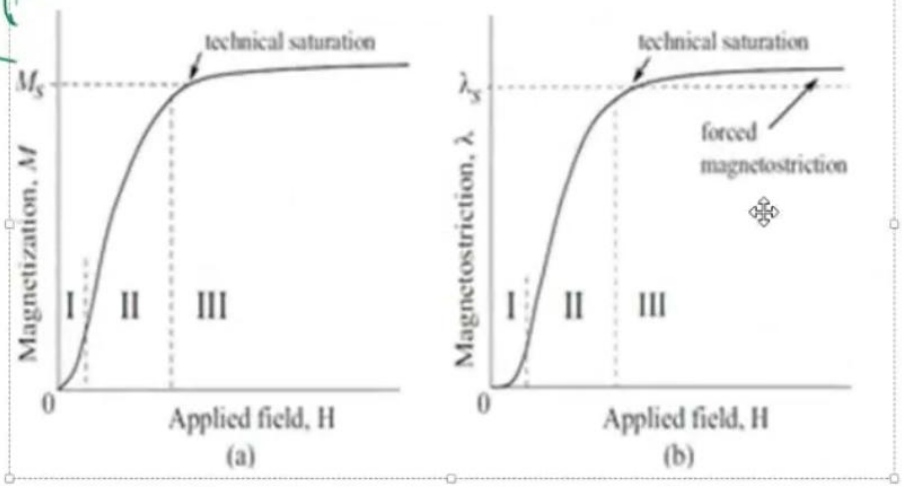
growing

$Size_0 < Size_1 < Size_2 < Size_3$



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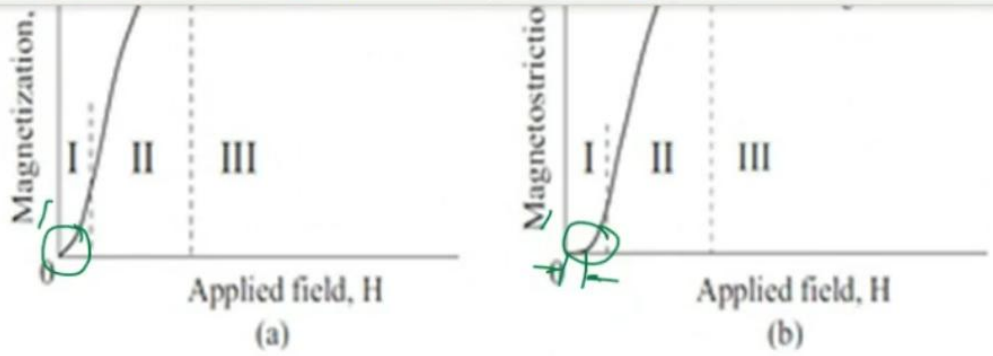

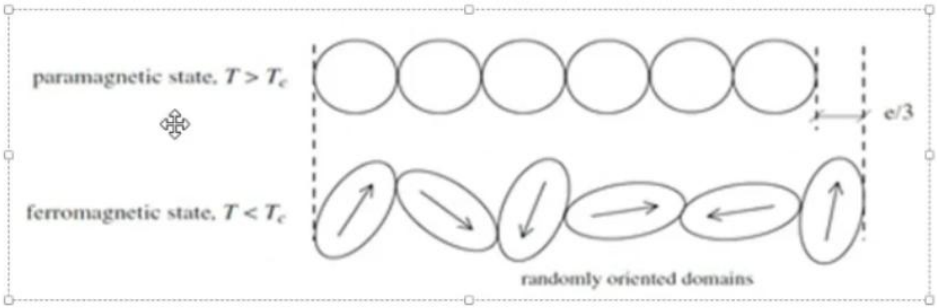

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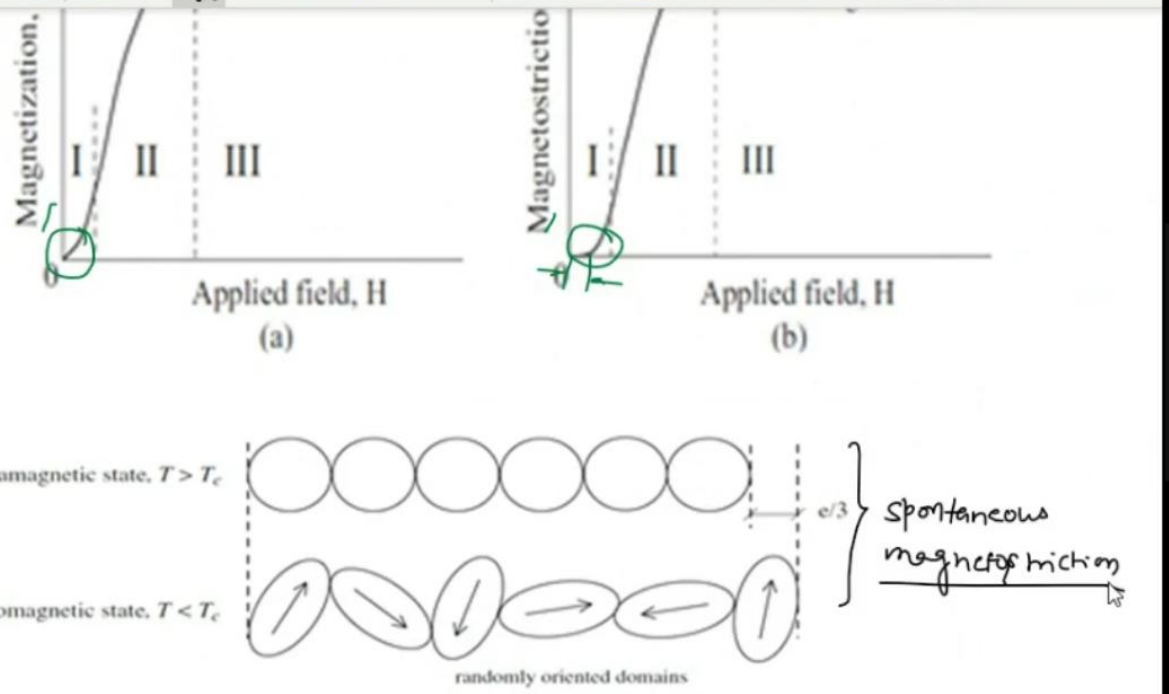

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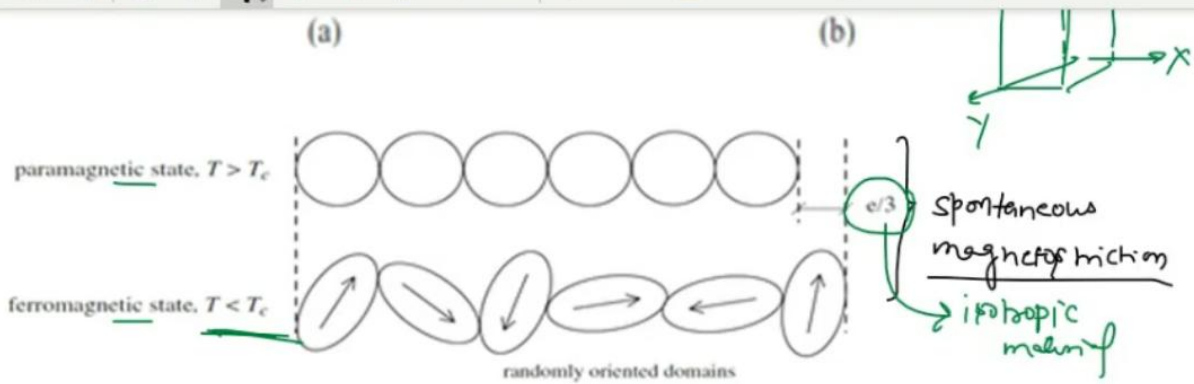
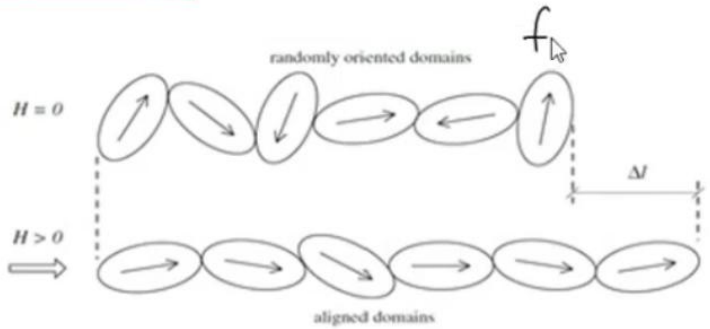


Field induced magneto-striction



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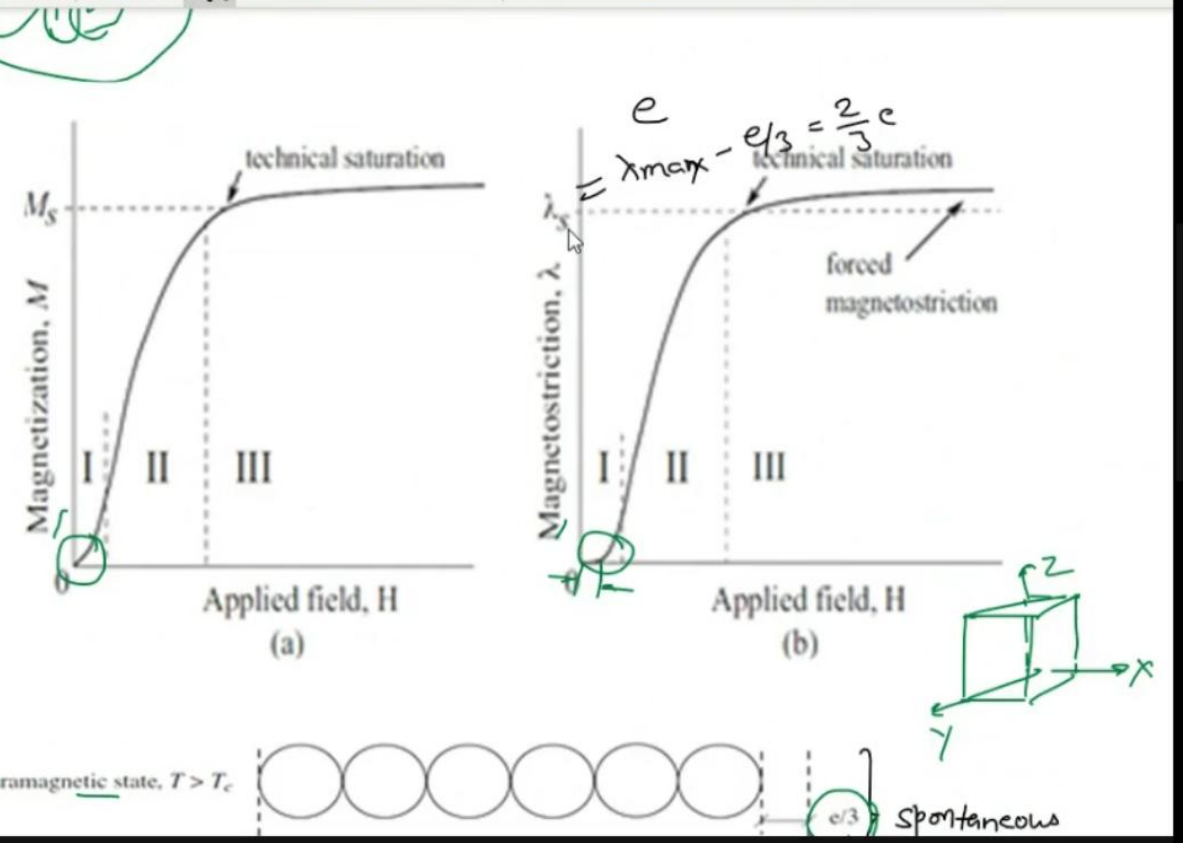

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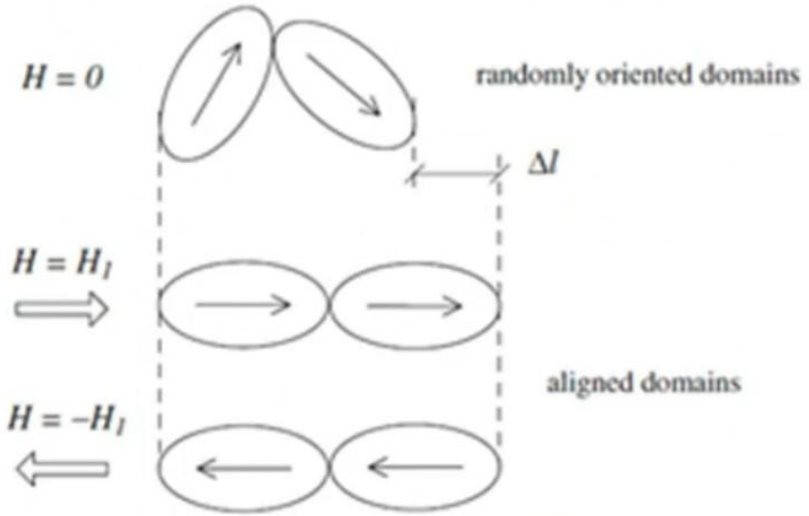
Magneto striction $= \frac{\Delta L}{L}$



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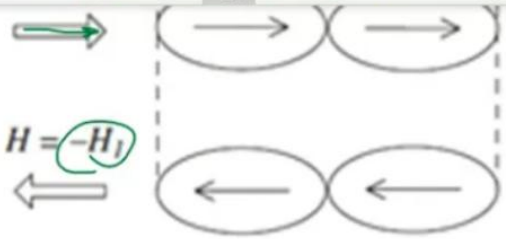
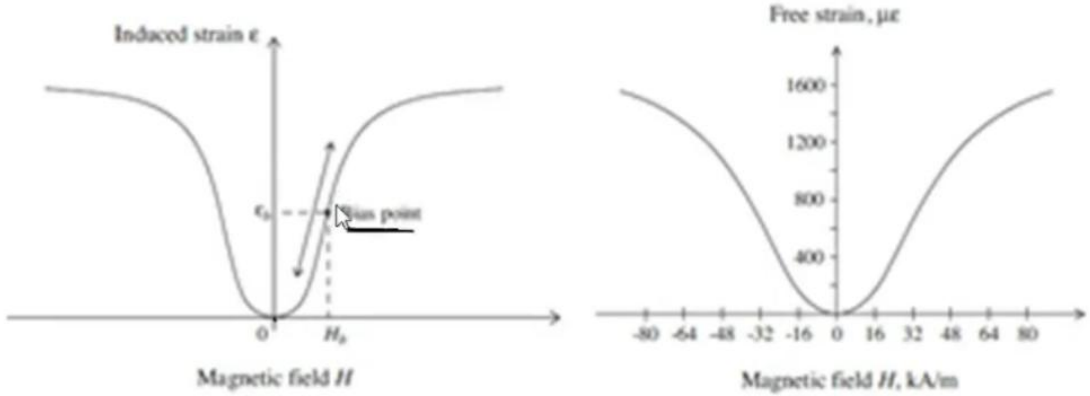


aligned domains



(a) Schematic of strain response

(b) Typical values for Terfenol-D

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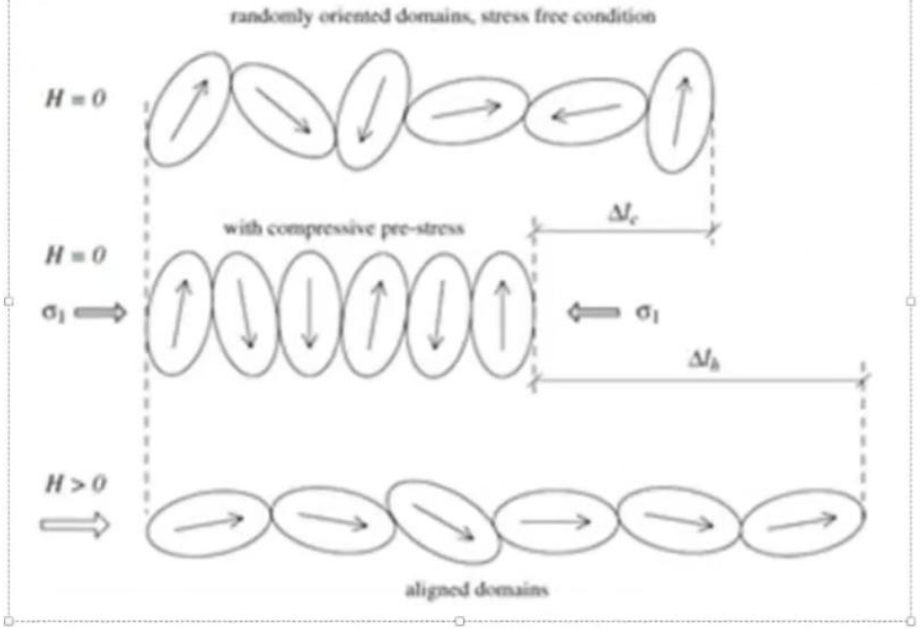

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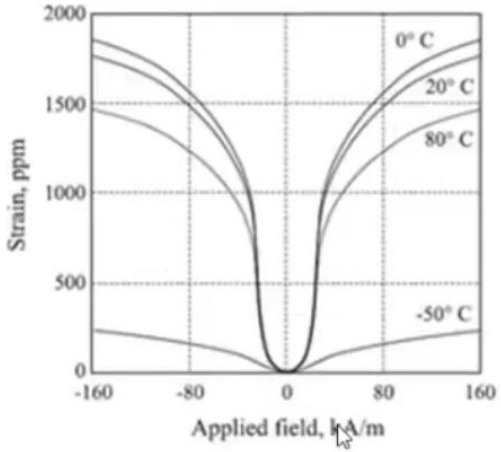
Terfenol-D



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$$\Delta E_{H_2H_1} = \frac{E_{H_2} - E_{H1}}{E_{H1}}$$

Nominal Composition	–	$Tb_{0.3}Dy_{0.7}Fe_{1.92}$
Maximum field induced magnetostriction, $\mu\epsilon$	Λ_s	1740
Young's Modulus, constant field, MPa	E^H	35–50
Young's Modulus, constant induction, MPa	E^B	40–65
Magnetic permeability, constant stress, Tm/A	μ^σ	$3–10 \times 10^{-6}$
Relative permeability	μ_r	5–10
Saturation magnetization, A/m	M_s	0.79×10^6
Magnetostrictive coefficient, m/A	d	$3–20 \times 10^{-9}$
Magnetomechanical coupling factor	k	0.7–0.75
Density, kg/m^3	ρ	9250
Resistivity, Ωm	ϱ	60×10^{-8}
Coefficient of thermal expansion, ppm/°C	α_T	12
Compressive strength, MPa	–	≈700
Tensile strength, MPa	–	≈28
Curie Temperature, °C	T_c	380

D

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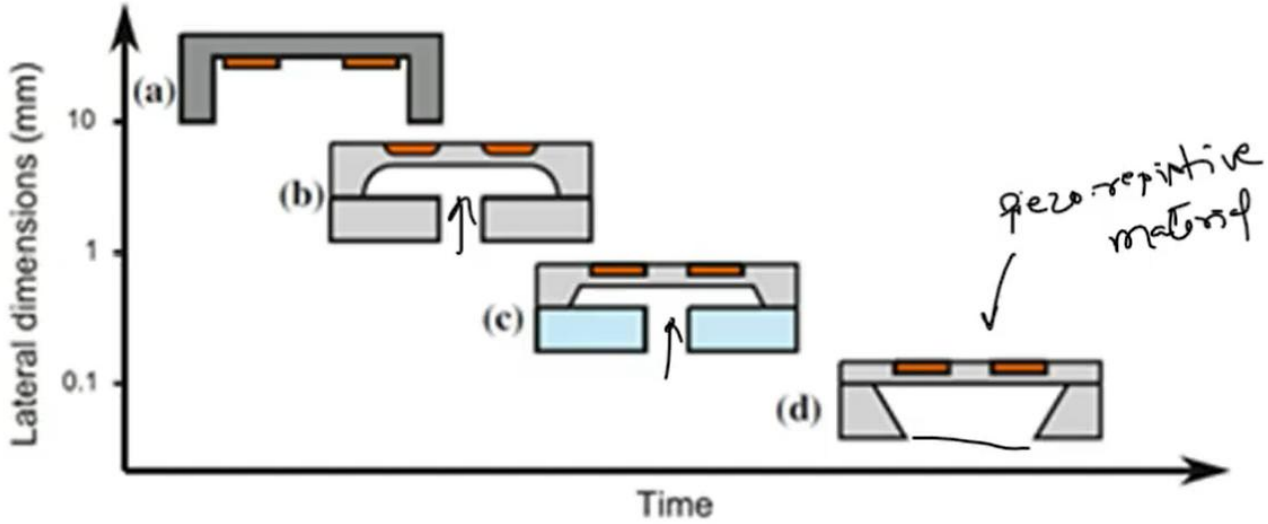
(8) Pressure sensor



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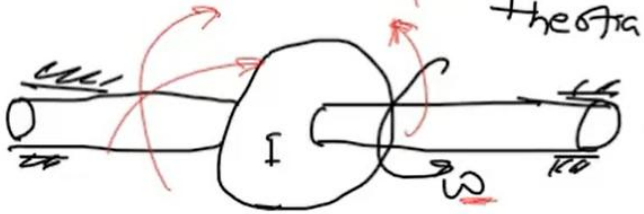
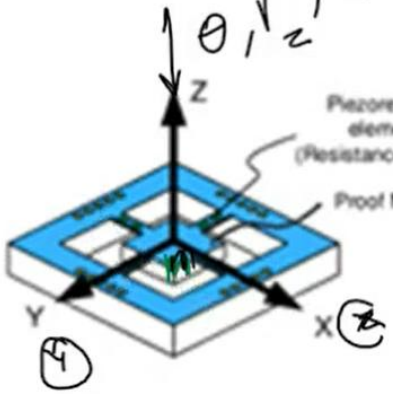
Aeroplanes, Satellite

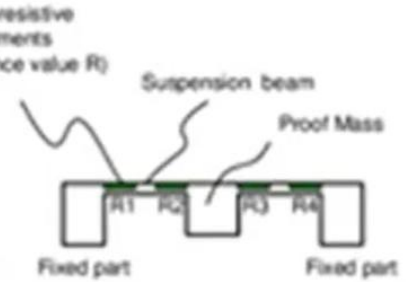
Theory



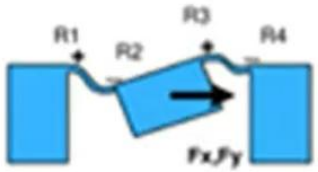
Aeroplanes ships



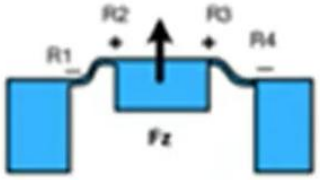
triaxial



Cross-sectional illustration of axial direction



Cross-sectional view of change in X or Y axes



Cross-sectional view of change in Z axes

D

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