EXPERIMENT NO. 1

Dielectric Ceramic → capacitors
Magnets → disk drive motors.

ADVANCE MATERIAL :-

Advance materials have the following properties.

(i) improved performance.

(ii) sustainability.

(iii) bendability / structural diversity.

Advance materials are used in :-

(i) Aerospace industries.
(ii) Electronic industries.
(iii) Defense-Oriented industries.
(iv) Automotive industries.
(v) Consumer goods.

INTEGRATED CIRCUIT :-

An integrated circuit is an assembly of interconnected electrical components, which is fabricated as a single unit on a substrate of semiconductor material.
The links are made up of low Resistance metal such as Al or Ag.
The pins coming out are also made up of gold.

PCB :- (composites of polymeric materials)
It is a board with in build circuits to link various ICs, resistors, capacitors together.
They are strengthened by glass fibres.

Transistor :- semiconducter devices to control, switch and amplify electronic signals and power.
2nd Fundamental block of electronics.
↑ Amorphous Silicon → main semiconductor!

semiconductor dominance
1st. Single Crystal Silicon.
2nd. ~~Amorphous~~ Silicon.

ant?

Q. Why organic molecules/polymers are imp for the advance materials?

Organic molecules/polymers are↑ having π-conjugated (hetero) aromatic backbone ∴ they are capable of transporting signals/charges and interact with light.

They can act as semiconducter in opto electronic devices.

They allow alter in functional prop by change in their molecular/monomeric units.

Properties of Graphene!

(i) Single layer C-atom arranged in hexgonal lattice.

(ii) Stronger than steel 200x.

(iii) Thinner than hair.

(iv) 2D material (first).

(v) Fire resistant, flexible and superb conductor. and provide insulation

→ Drug towards target cells.

→ Bendable phones & large batteries.

→ sensors of liquids/gases etc.

Application SMIA(S).
Robatic hands.
Cardiovascular Stents.
Heat engines.
Biomedical.

ation of
Hydroxyapatite.

Bone grafting

Bone augmentation

restoration of periodontal defects.

Orthopedic & dental implants.

Application of Piezo electric Materials.

transcuder US-scanning

Acutors (vibration suppressi
inoptical & micro
electronic engineerin

pressure sensing devices

gyroscope.

EXPERIMENT NO. 2

Plasticity :- ability of substance to permanently deform when a force greater than its limit point is applied.

↳ Plasicity in turn depends upon the property of the metal to have certain faults in its structure known as dislocations.

Grain boundary; ad atom; substitutional atom.

Vacancy. When an atom is missing from an ideal crystal structure

Interstitial: Atoms that are much smaller than the host atoms within the normally empty regions / interstices.

Dislocations: - Extra half row of atoms in the structure; characterized by burger vector → magnitude of dislocation
→ orientation

hard metal (1mm)
soft metal (2mm)

EXP – 6 :-

Steps of Mettalography :-

(i) take a specimen
(ii) Mount
(iii) Grind (washing)
(SiC paper of a certain grid no.)
(iv) Polishing
(Alumina suspension (a very mixture alumina powder
slurry
diamond paste
Alumi
SURRY
(washi
(V) Ectching → Nital
→ Picrol
(eth
(Vi) Optical microscopy
Biological
Metallo
(wash & dry)

Magnification = Apparent size of final image / size of object (800x)

total magnification = objective; eyepiece magnificat

Nital + Picrol ⇒ ferrous materials.
HF echants ⇒ Al-based alloys
Ferric Chlorid ⇒ in general.

N = 2^(n-1)
N = no. of grains observed per 100x magnification
n = grain size.

PRINCIPLE OF MICROSCOPE :-

Reflected light is used to examine the speciemen. A horizontal beam of light is reflected by the means of plane glass reflecter, downwards through a microscope objective towards the speciemen.

Some reflected light passes through lower lens system to be magnified, → objective, → plane glass reflecter → upper lens system to be modified again.

PERIMENT NO. 12.

—— X ——

SPUTTERING! → sputter etching.
→ sputter deposition.

A non thermal vaporization proces in which surface atoms are physically eject by momentum transfer from an energetic bombarding species to generate a flux of ions that are incident on the target atoms to eject then into gas phase and getre deposited on a substrate particle.

→ vaccum
→ E 500 - 1000 V
→ P 10^{-2} to 10^{-1} V

sputtering yield is independant of temp. but depends upon the inital incident particles. (ion mass, target modification, angle of incidence, no. of atoms ejected / incident ions.

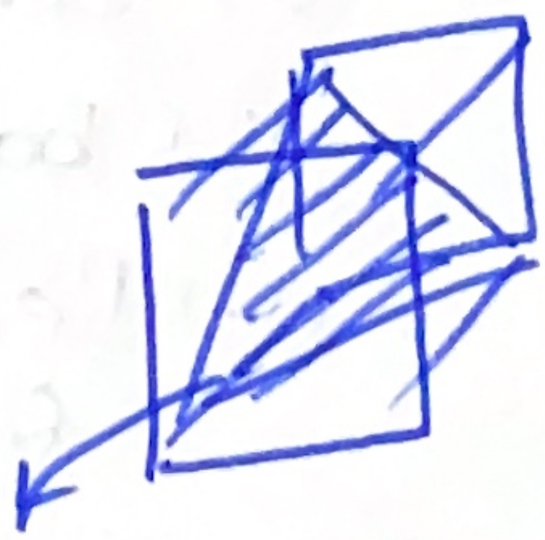
* Target material can liberate :-
  (i) Neutral atoms.
  (ii) Ionized atoms
  (iii) backscattered atoms!
  (iv) Reabsorption of gas atoms from the target surface.

* Target material undegoes
  collisional cascades
  point defects.
  local heating.
  + Amophization.
  a implantation.

* Two modes of sputtering.
  compound coated cathode.
  metallic cathode.

- unlimited range of source / film material
- great adhesion.
- uniformity of film thickness
- ease of multipurpose / component films.
- low temp deposition of refractory materials.

- Insulating layes
- layer in CD.
- Piezo electric transcuders
- Memory devices
- High temp semiconductors.
- Thin film on resisters & capaciters!
- Transparent coating on conducting electrodes.



$$\text{Area} = \frac{\sqrt{3}}{4}\left(\sqrt{2}a^2\right)$$

TENSILE TEST - M

Q. Why performing engineering tests on material important?

The mechanical properties of a material are an important information to consider, to determine this/these properties a wide range of mechanical tests have been design that characterize the mechanical responses of materials and predict their performance as realistically and producibly as possible.

Q. define tensile test. (it defines propotionality limit, elongation, reduction in areas, tensile strength, yield point & streng

In Tensile test, the speciemen is subjected to a continuall uniaxial tensile force at a constant rate; consequently a stress-strain curve is drawn from the load-elongation measurements.

Q what are the importance of tensile test.

Tensile test are important because

(i) Widely used to provide basic design information on the strength of a material.

(ii) It is an acceptance test for the specification of materials.

Q. What are the 2 types of tensile tests:-

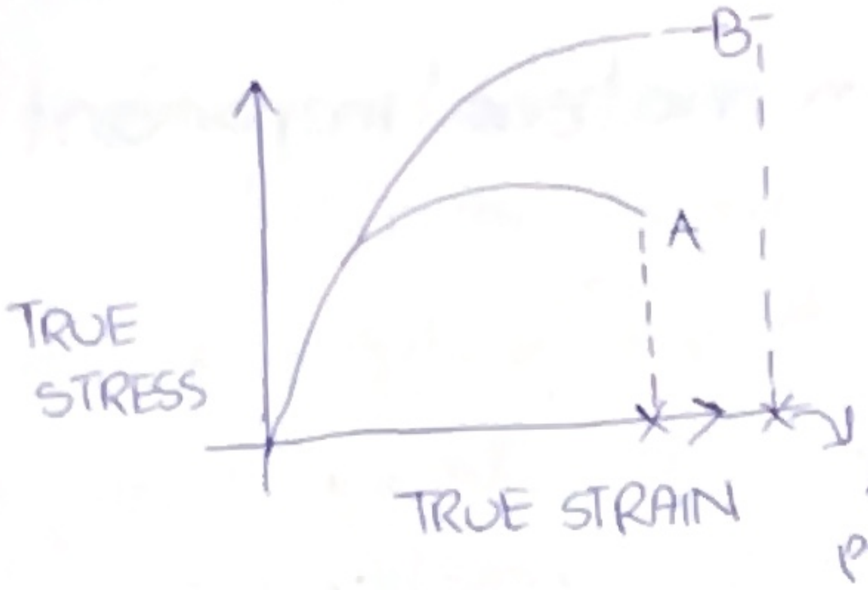
A tensile machine may elongate the specimen at a constrate and to continuos measure the inst load applied (load cell) and resultin elongations via extensometer

There are essentially two types of machines for tensile testing:

(i) screw-driven machines. (Mechanical)

(ii) Servo-hydraulic machines

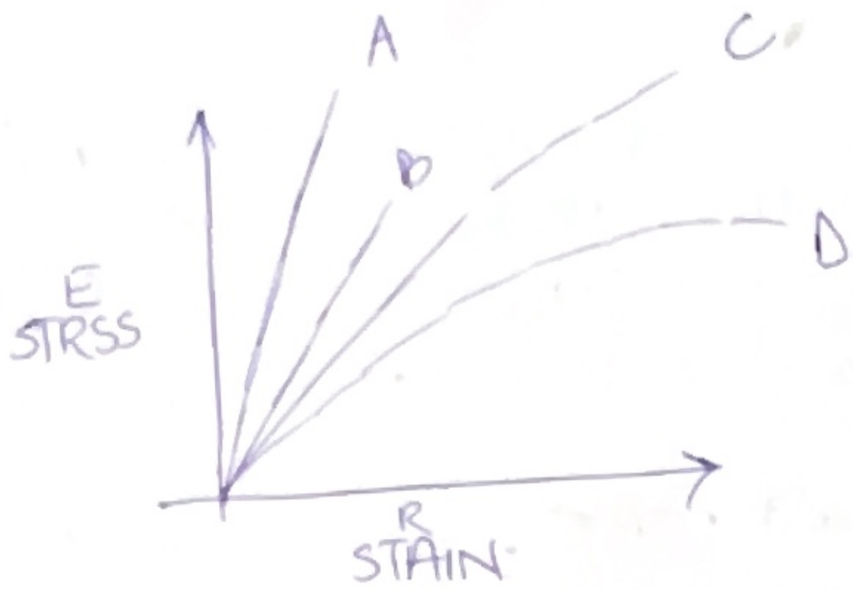
conventional measures of ductility are
(i) Reduction of Area
(ii) Elongation.



① Curves of ductility.

After the yeild point; see for the curve in which the strain continues to increase without fracture ie plastically deformation

∴ B is more ductile.

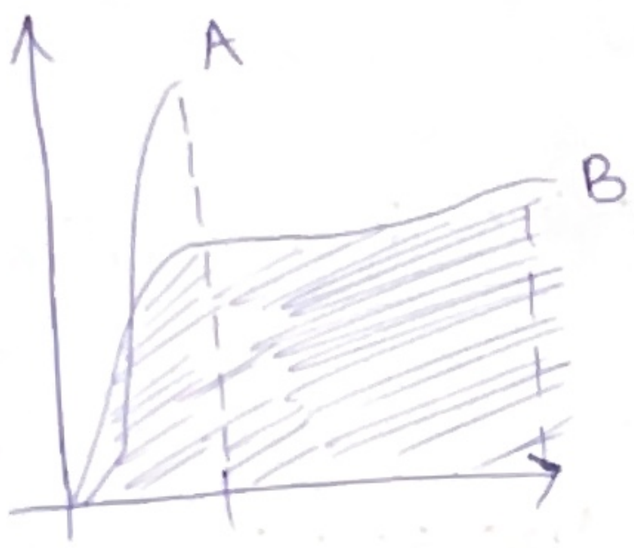


② Curves of Elastic Modulus.

$E = \frac{\sigma}{\varepsilon}$ (stress / strain)

greater the slope of stress/strain curve greater will be the elastic modulus.

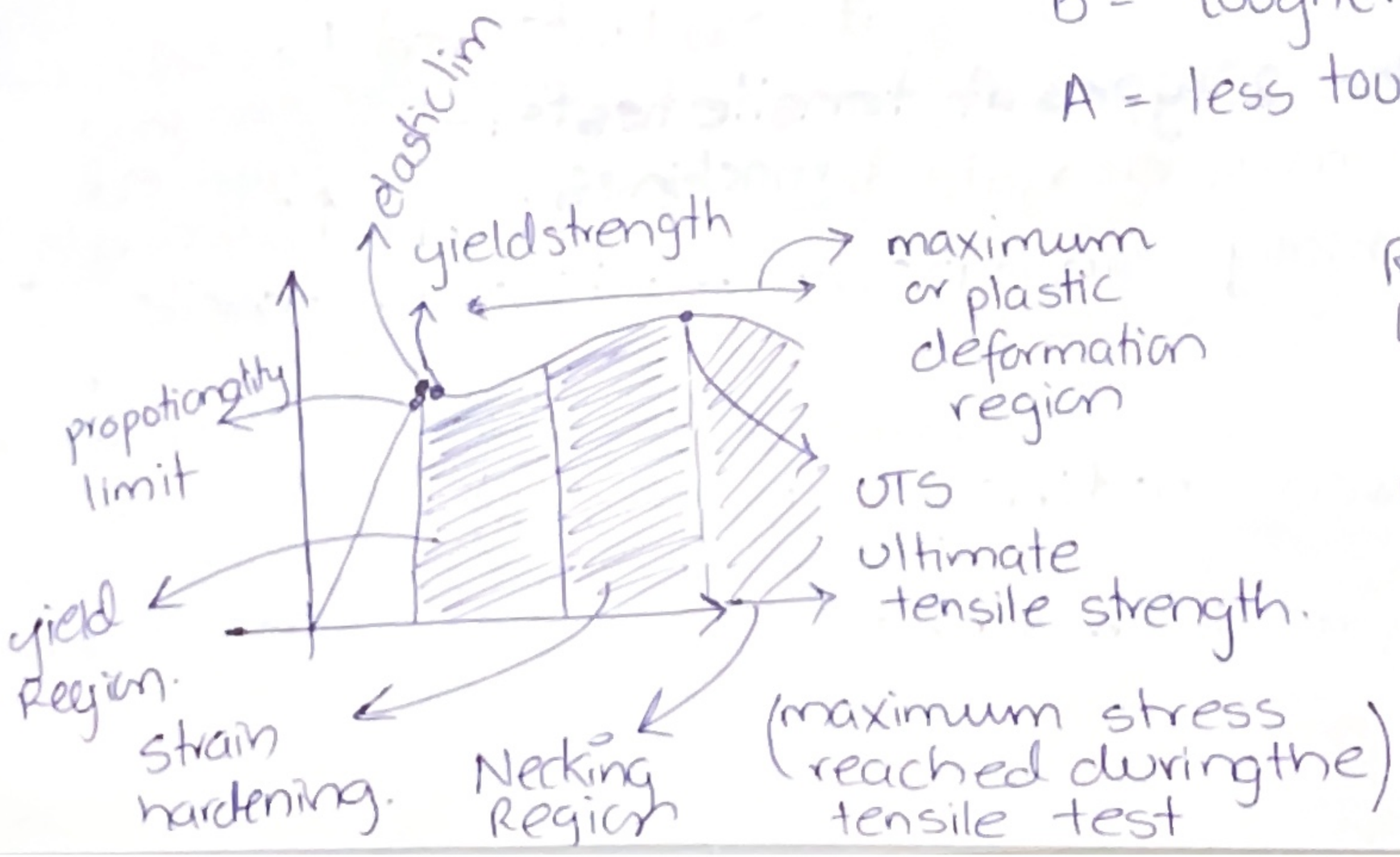
∴ A ⇒ highest E (GPa, psi)
D ⇒ lowest E.



③ Curve of Toughness
↳ ability to absorb energy before fracture

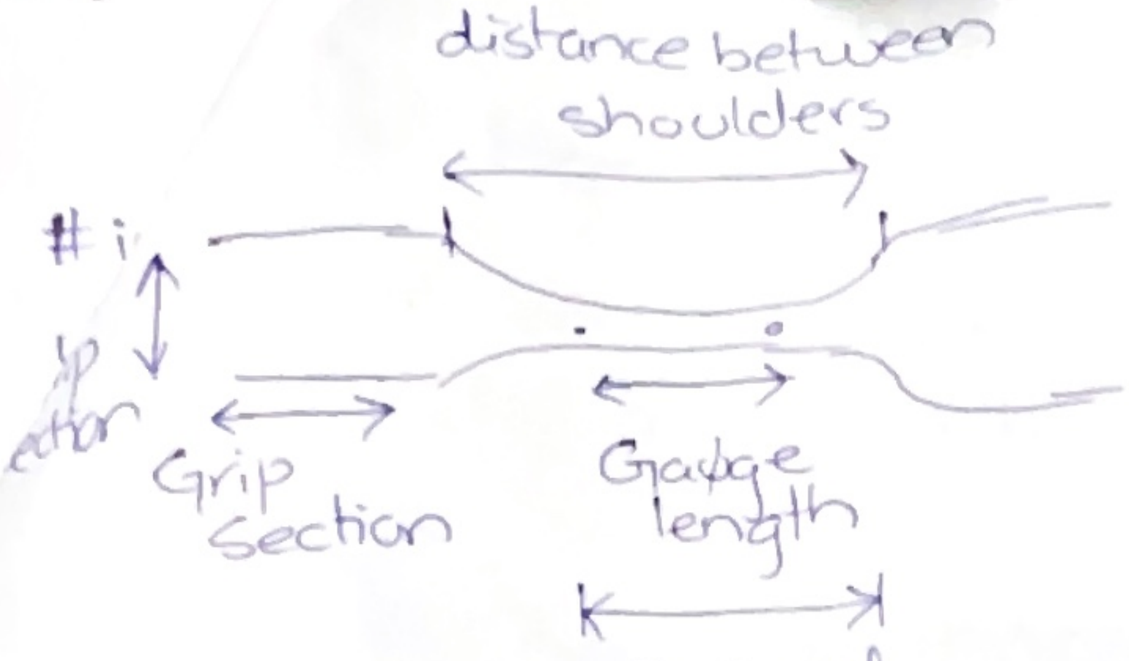
greater area under the curve means greater toughness

B = tougher.
A = less tough.



Resilience
↳ ability to absorb energy when deforming elastically.

SLIDES.



ASTM E8/E8M-11
Standard test methods for tension testing of metallic materials.

ASTM D638-10
standard test method for tensile properties of plastics.

(i) In metals elastic deformation only persists till 0.005

(ii) The point after which at elongation the stress & strain are not propotional to one another is called the propotionality limit after it plastic deformation occurs.

(iii) Yeild strength is defined as the stress to produce a small plastic deformation (it is measured at 0.2% offset).

(iv) UTS is the maximum engineering stress reached at a tension test.

(v) Yeld Region:- plastic deformation without significant stress showing some room of reversal.

(vi) Necking Region:- thining due to plastic deformation.

(vii) Strain hardening
hardening of material by plastic deformation

HARDNESS - TEST - M (strength the ability to Resist F & P)

:fine Hardness.

Hardness is defined as the material's property to the resistance to permanent deformation (i.e indents/scratches)

Q. What is the importance of Hardness type test.

Hardness does not measure a fundamental property however testing it can give valueable information about different aspects of a material.

Q. Generally explain the phenomena of hardness testing.

The hardness test is done by essentially making indents on the surface of the speciemens material. This test is further divided into 3 types on the basis of the type of indenters, size/shape of impressions and the applied load. i.e (SCRATCH & INDENTOR METHODS)

[INDENTOR METHOD] [INDENTERS] → Quantify hardness

(i) Brinell Test (D 10mm) Hard steel / Tungsten Carbide ball.
L.R ⇒ 3000 - 500 kg L.T = 30 second

(ii) Vickers Test Diamond pyramid
L.R = 1 - 120 kg L.T = 10 - 15 sec

(iii) Rockwell Test. Diamond cone. /steel ball.
↳ Reading from analog dial.

[SCRATCH METHOD]

(i) Tells the hardness defined/compared by a scale predefined i.e Moh's scale ; to know where the material scratches.

[REBOUND/DYNAMIC "]

(i) Tells about the hardness using scleroscope, the known rebound ↓ height is taken into consideration

→ Brinell test ; describe hardness relative to the diam of the ball / and the indent.

$$BHN = \frac{2P}{\pi D[(D-(D^2-d^2)^{1/2}]]}$$

P = applied load
d = diametre of indent
D = diametre of ball

→ Vicker's hardness test tells about the hardness relate to the diagonal length of the indent.

$$H_V = [1.854\ P/L^2] \Rightarrow \left[\frac{2F\sin^2\Phi/2}{D^2} \quad \Phi = 136^\circ\right]$$

P → applied load. L → length of diagnol (indent)

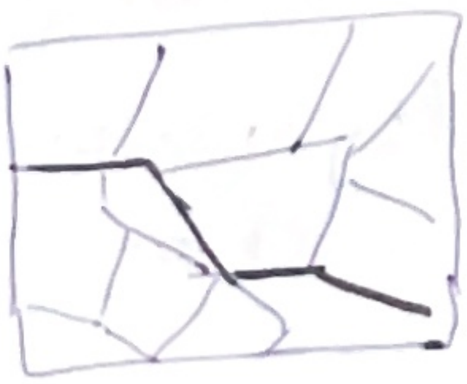
→ Rockwell Hardness test tells about hardness by the depth of the impression, USING, a particular scale

Q. some industrial areas where hard coating / surface are important.

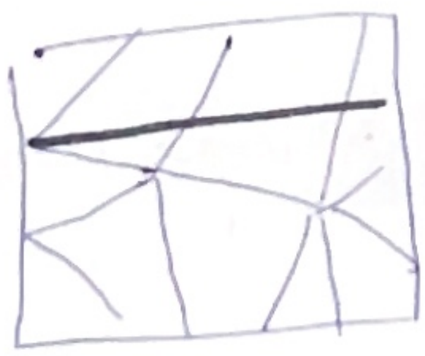
(i) Cutting tools / maching equipement.
(ii) Automotive industry.
(iii) Aerospace industry.

NOTE

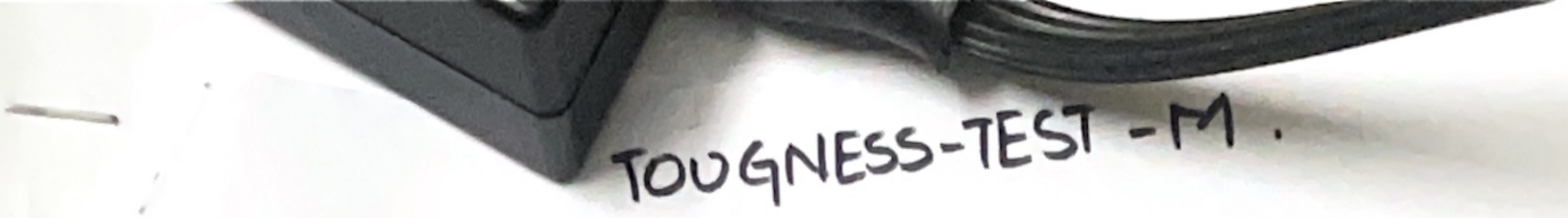
| we grind and polish a material before hardness test. (take atleast 5 reading) and take avg.
| For BHT use equ.
| For VHT & RHT take values directly from the machine.



Transgranule Fracture (Ductile)



Intergranule Fracture (Brittle)



TOUGNESS-TEST -M.

Define toughness:-

Taughness is defined as the materials ability to absorb energy before fracture point.

Q. Define Impact test functionality.

The impact testing is used to measure the toughness material and standardize it. The two commonly used impact testing methods are. The two types are.

(i) Charpy test

(ii) Izod test

NOTE:-

The amount of energy absorbed by the sample before fracture is found from refrence to the Φ/angle of displacement.

Q. DEFINE STIFNESS :-

Stifness is the ability of a material to return to its orignal form without plastic deformation (without) after being subject to a force.

Q. state the differences between two impact test.

metal
Ferrous
Non Ferrous
plastic
Thermo
Thermosetting
Charpy test
composite
Fiber
laminated
Izod test.

(i) The specimen is tested non vertically or horizontally.

(i) The specimen is tested vertically.

(ii) The length of the specimen is less as compare to the izod test

(iii) The specimen is hit by the hammer from the back.

(iii) The specimen is hit by the hammer from the front.

TOUGHNESS SLIDES.

#ir ollowing types of Bridging reeinforce a material.

Ur (i) Whisker Bridging (uses long thin crystals called whiskars)

(ii) Fiber Bridging

(iii) Grain Bridging.

(iv) & Ductile 2nd phase Bridging. (Ductile phase within a brittle matrix that deforms plastically and thus reenforce cracks etc.)

HARDNESS SLIDES:-

Hardness tested by :-

- Scratch Method (Qualitative test)
- Rebod Dynamic Hardness li (Quantitative test) → leep hardresstest.
- Indentation Method (Quantitative test)

Tal-Amber → sapphire → diamond.

Rebound HT: Hardness measure by the height of the indenter that falls on the material.

INDENTOR METHODS

- Brinell
- Vickers
- Rock well
- Nano Indenter

Rockwell Hardness:-

Minor load of 10kg is applied and zero reference position is established.

The major load is applied for a specific time i.e (dwell time)

scale	Major Load	shape	indenter
A	60	cone	Diamond
B	100	O (1/16 D).	steel
C	150	cone	Diamond

Nano-indentation:-

↳ imp for properties of nano material or micro materials.

↳ The hardness of hard thin film is measured and the indenter does not penetrate the substrate.

BHT
- fast
- inexpensive
- no hardness value of individual grain possible due to a ball being used.
- not sensitive to imperfections
- material thickness < 10 x the indenter.

VHT
- slow
- expensive
- hardness of single material grain is known.
- only for metals as thin as 0.15mm.

RMT.
- direct values
- distinguish small hardness diff.
- thickness limit only end at 0.15mm (not measurable below)