

magnetic properties of Ferrites..

By :- Gouri govind jadhav
M.Sc., SET

VIVEKANAND COLLEGE, KOLHAPUR
(EMPOWERED AUTONOMOUS)

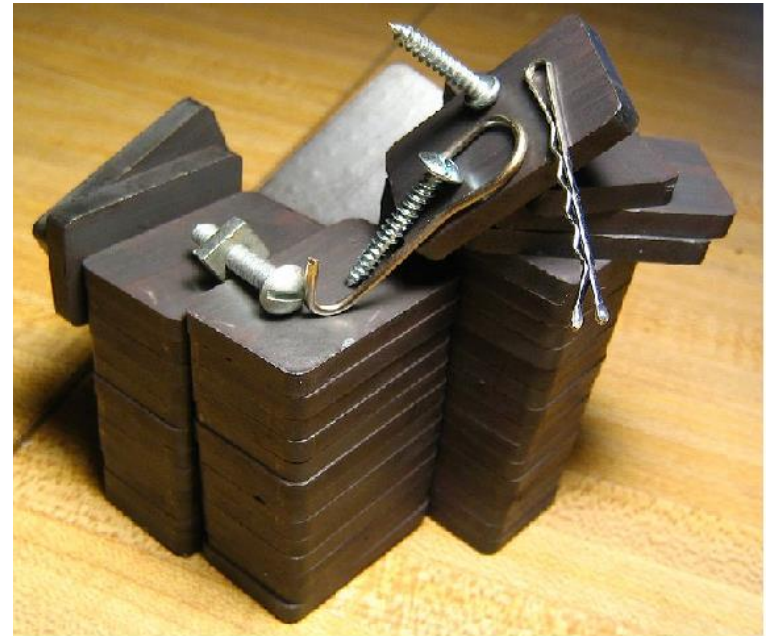
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➤ What is ferrite?

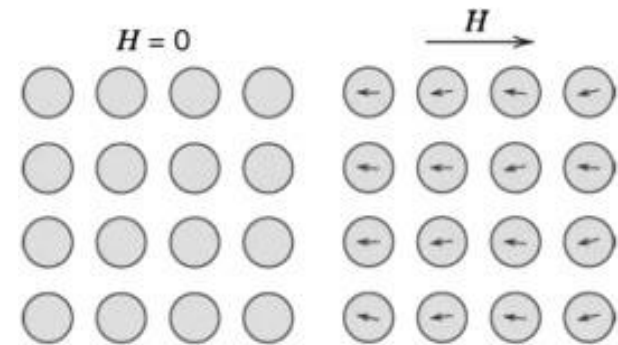
- ▶ A **ferrite** is a ceramic material made by mixing and firing large proportions of iron oxide with small proportions of one or more additional metallic element .
- ▶ It's composition is MFe_xO_y .



➤ Types of magnetic materials

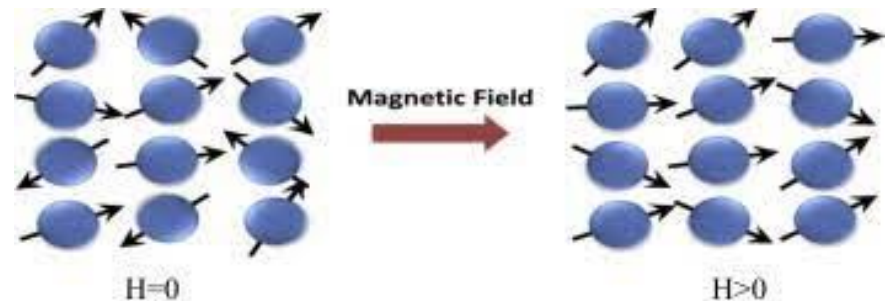
❑ Diamagnetic material :-

- ▶ When placed in strong external magnetic field , acquire weak magnetism opposite to the direction of applied magnetic field.
- ▶ Weakly repelled by magnet .
- ▶ E.g. Copper, Zinc



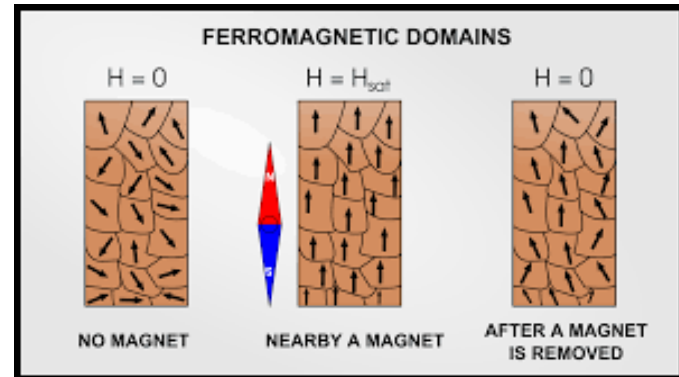
❑ Paramagnetic material:-

- ▶ When placed in strong external magnetic field ,acquire weak magnetism in same direction of applied magnetic field .
- ▶ Weakly attracted by magnet .
- ▶ E.g. aluminium , oxygen etc.



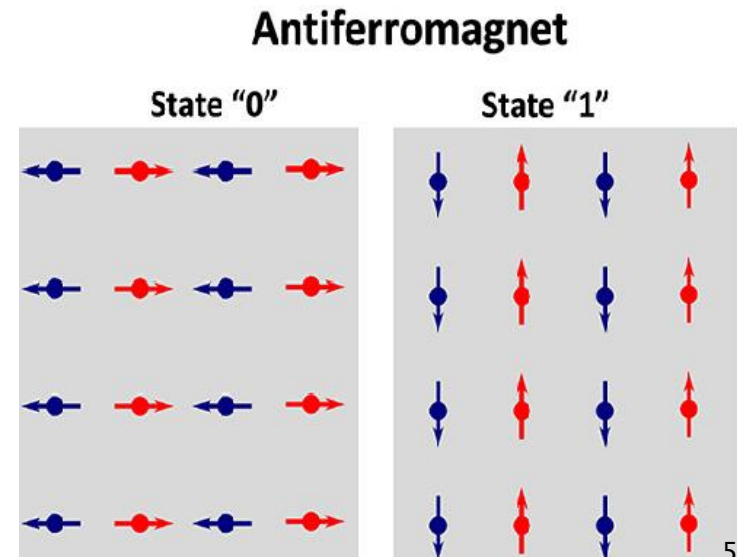
❑ Ferromagnetic material:-

- ▶ Acquire strong magnetism in the direction of applied magnetic field .
- ▶ Ferromagnetic substances are strongly attracted by the external magnetic field.
- ▶ E.g. iron, nickel etc.



❑ antiferromagnetic material:-

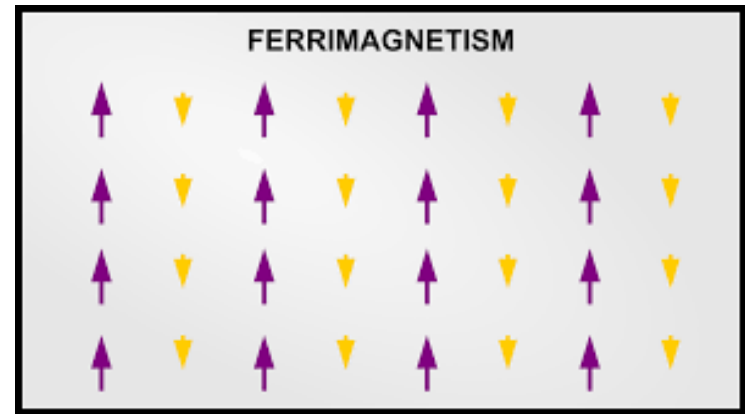
- ▶ An antiferromagnetic material that has antiparallel magnetic moment .
- ▶ magnetic moment is zero.



❑ Ferrimagnetic material :-

- ▶ A ferrimagnetic material is a material that has populations of atoms with opposing magnetic moments.

For ferrimagnetic materials, these moments are unequal.



□ Classification of ferrites

spinel ferrite (MFe₂O₄)



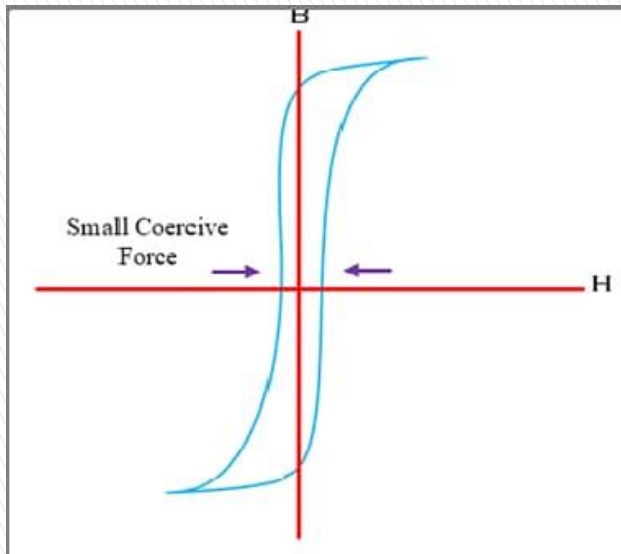
Normal spinel

Inverse spinel

random spinel

Soft ferrite

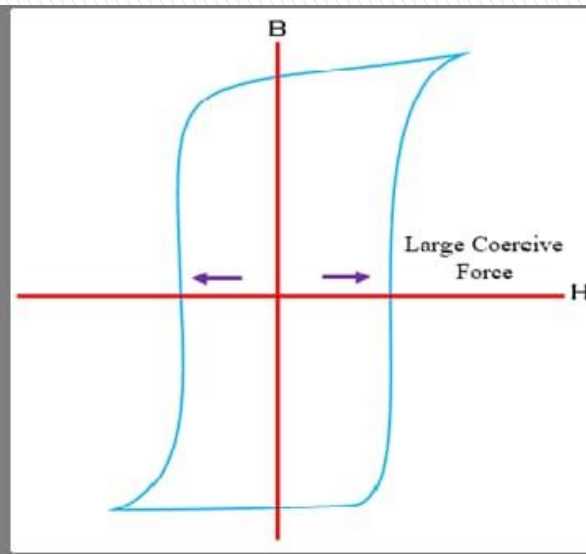
- ▶ Not permanent magnets .
- ▶ Low coercivity.
- ▶ Easy to demagnetize.



(a)

Hard ferrite

- ▶ Permanent magnets .
- ▶ High coercivity .
- ▶ Difficult to demagnetize.



(b)

□ Microwave synthesis process

➤ Principle:-

A microwave oven heats the material by passing microwave radiation .

➤ Synthesis:-

- ▶ This method is used to here to ceramic powder .
- ▶ Set temperature → auto-combustion starts → temperature reaches high



release gas ← rapid formation and crystallization

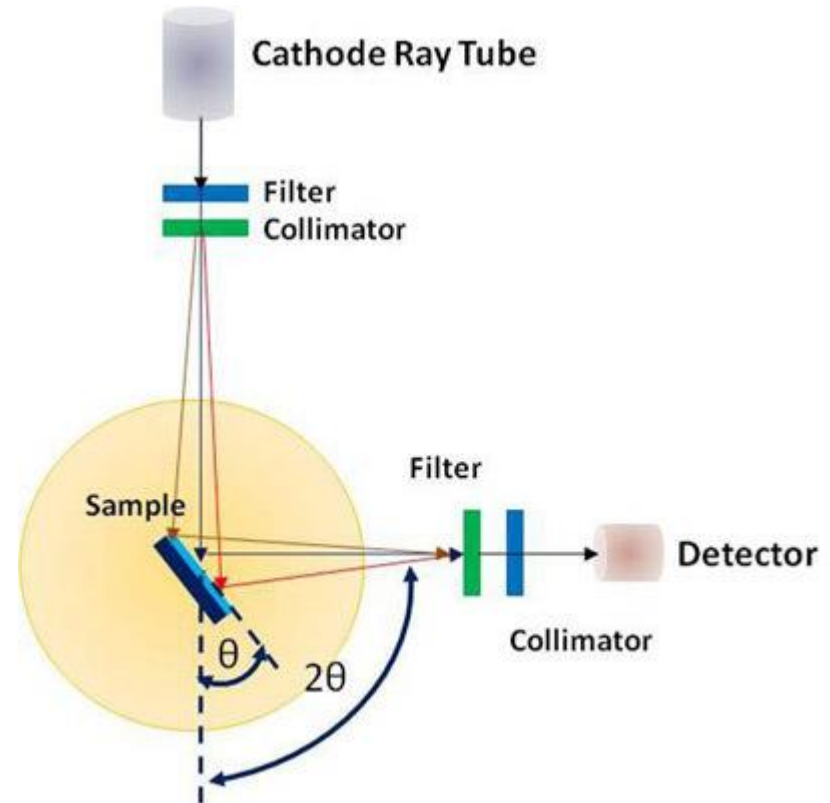


□ XRD characterization

- ▶ X-ray diffraction analysis is a technique used to determine the crystallographic structure of a material.
- ▶ Incident X-ray beam → interacts with atoms/electrons → interfere constructively & destructively.

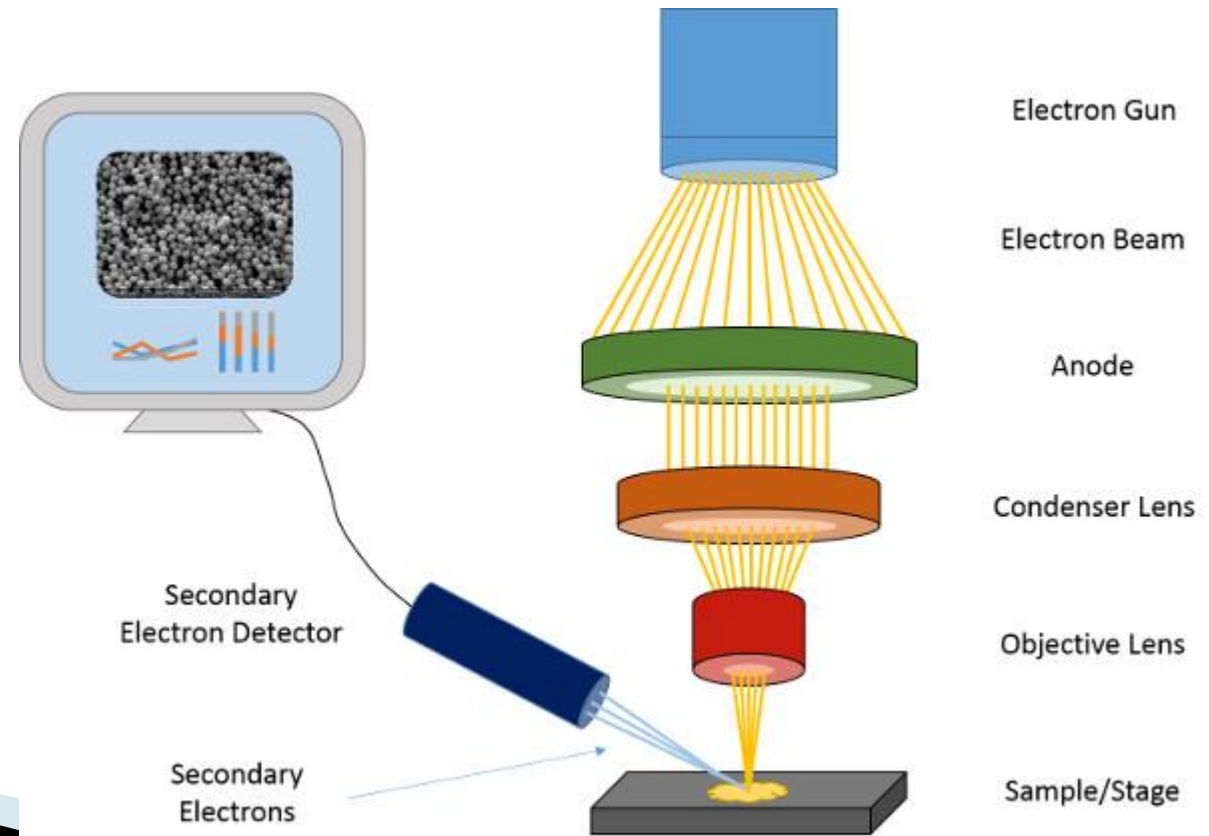
Bragg's law :-

$$2d\sin\theta = n\lambda$$



□ SEM characterization

- ▶ A scanning electron beam microscope (SEM) scans a focused electron beam over a surface to create an image .
- ▶ It gives us Morphology of sample.



Thank you

A decorative graphic at the bottom of the slide consisting of a dark blue wavy shape on the left, a black horizontal bar, and a light blue wavy shape on the right.