Al-Mustaqbal University

Department of medical physics

Second stage

Magnetism

Fourth Nine

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Classification of Magnetic Materials

4-Antiferromagnetic materials

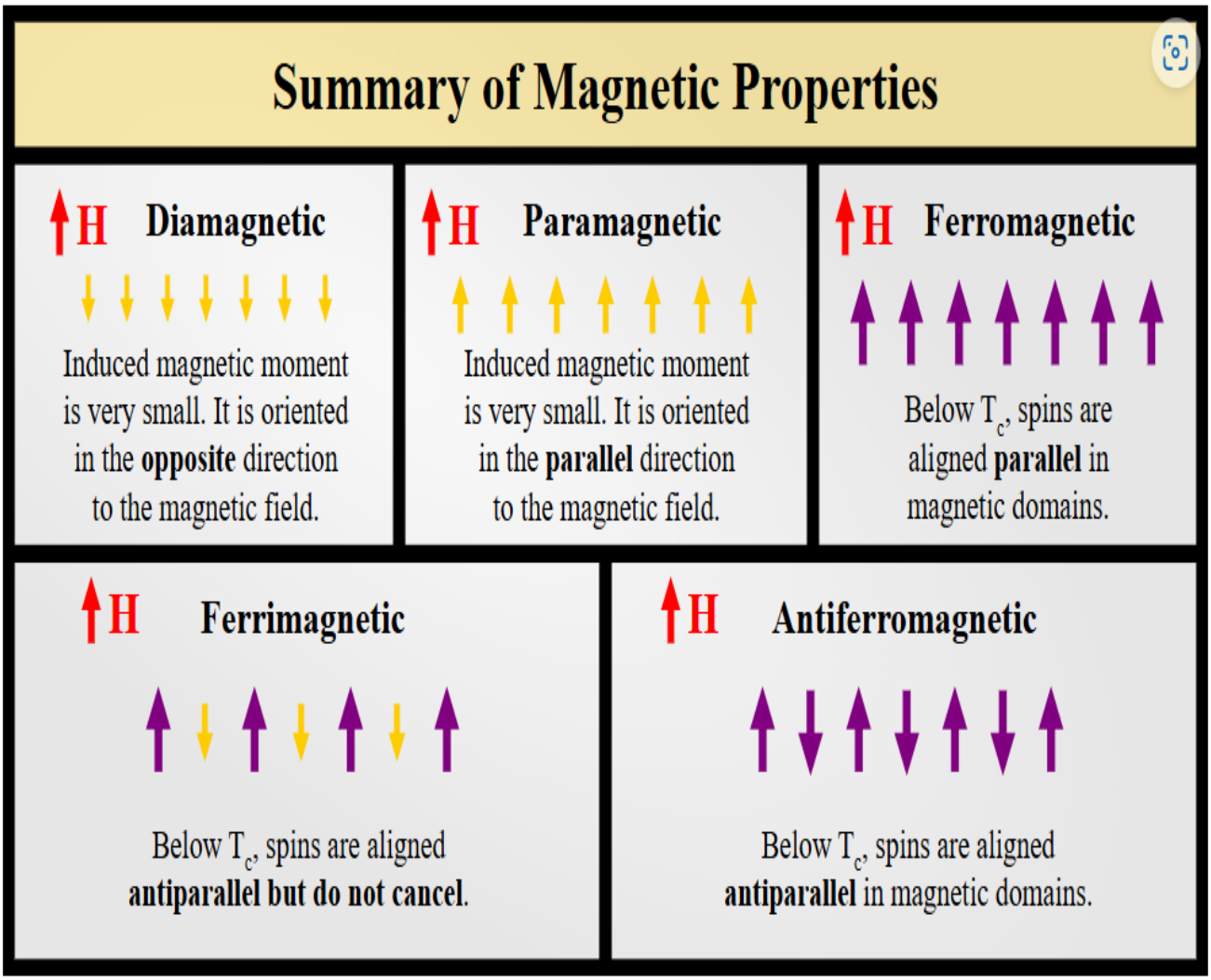
Is have spin alignment like ferromagnetic materials; however, while ferromagnets align atomic magnetic moments in the same direction, antiferromagnets align the magnetic moments in opposite directions.

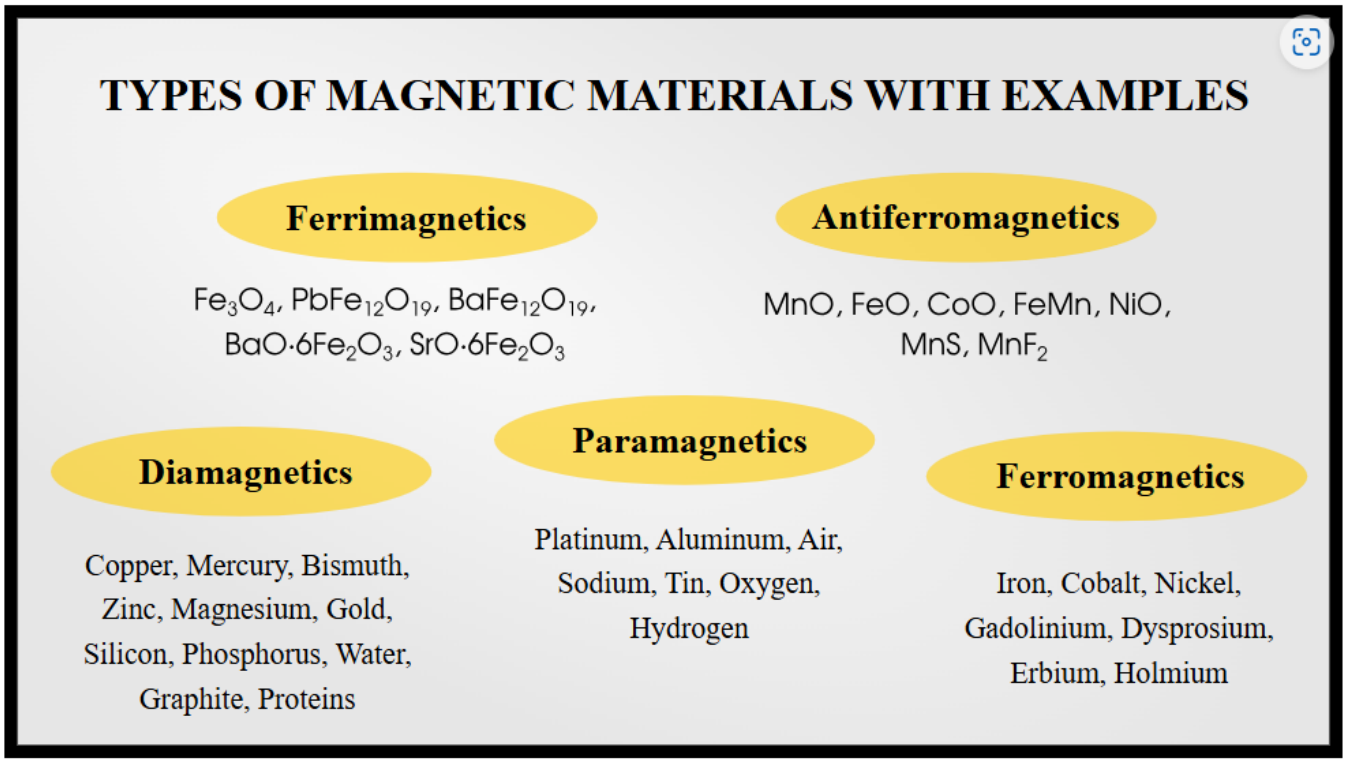
In other words, antiferromagnets moments perfectly pair up against each other, leading to **0 total magnetism** (in theory, but in practice there are crystal defects so the moments are not perfectly opposing each other, so the total magnetic moment is greater than 0).

5- Ferrimagnetic Materials

If you've ever seen a ceramic refrigerator magnet, that was probably a ferrimagnet. Ferrimagnetic materials behave very similarly to ferromagnetic materials. However, ferrimagnets work by the same indirect superexchange as antiferromagnetts.

While antferromagnets completely cancel each other out because each pair of magnetic moments are equal, ferrimagnets only have partial cancellation. Which means they really have partial magnetization.


Summary of Magnetic Properties
H
Diamagnetic
Induced magnetic moment is very small. It is oriented in the opposite direction to the magnetic field.
H
Paramagnetic
Induced magnetic moment is very small. It is oriented in the parallel direction to the magnetic field.
H
Ferromagnetic
Below T_c, spins are aligned parallel in magnetic domains.
H
Ferrimagnetic
Below T_c, spins are aligned antiparallel but do not cancel.
H
Antiferromagnetic
Below T_c, spins are aligned antiparallel in magnetic domains.


TYPES OF MAGNETIC MATERIALS WITH EXAMPLES
Ferrimagnetics
Fe_3O_4, $PbFe_{12}O_{19}$, $BaFe_{12}O_{19}$, $BaO{\cdot}6Fe_2O_3$, $SrO{\cdot}6Fe_2O_3$
Antiferromagnetics
MnO, FeO, CoO, FeMn, NiO, MnS, MnF_2
Diamagnetics
Copper, Mercury, Bismuth, Zinc, Magnesium, Gold, Silicon, Phosphorus, Water, Graphite, Proteins
Paramagnetics
Platinum, Aluminum, Air, Sodium, Tin, Oxygen, Hydrogen
Ferromagnetics
Iron, Cobalt, Nickel, Gadolinium, Dysprosium, Erbium, Holmium