

Applied Physics Lecture 9th and 10th

Chapter 7

Magnetism and Electromagnetism

Magnetic materials


Magnetic materials are Iron, steel, Nickel, Cobalt etc. and non-magnetic materials are plastic, rubber, paper, glass, air, wood etc.

How materials become magnetize

Materials like iron, cobalt, nickel etc. are magnetic materials because they are magnetized when placed under magnetic field of a permanent magnet. That's why permanent magnets attract iron, nails etc. because these objects are magnetized and when removed from magnetic field they lose their magnetism.

Due to orbital and spin motion of electrons within an atom, minute magnetic domains are created in the ferromagnetic materials. These domains can be considered as small bar magnets. In the absence of external magnetic field these domains are randomly oriented and cancel each other's effect. The domains align themselves in the presence of magnetic field and object itself becomes a magnet.



(a) The magnetic domains (N  S) are randomly oriented in the unmagnetized material.



(b) The magnetic domains become aligned when the material is magnetized.

Ferromagnetic Materials

Such materials that are easily and strongly magnetized in the direction of external magnetic field are known as ferromagnetic materials.

The magnetic materials are termed as ferromagnetic materials. Examples are iron, cobalt, nickel etc. They have high values of relative permeability 50-5000. Permanent magnets used in

loudspeakers, generators, motors and microphones are made from Alnico (alloy of aluminium, nickel, iron and cobalt)

Paramagnetic Materials

Such materials that are weakly magnetized in the direction of external magnetic field are known as paramagnetic materials.

They are better than air but weaker than ferromagnetic materials. Examples are aluminium, chromium, manganese, platinum etc.

Each atom acts as magnet but the domains are randomly oriented in the absence of field. They are temporarily aligned in the presence of field. Their overall magnetic effects are weaker than ferromagnetic materials. Their permeability is slightly greater than one.

Diamagnetic Materials

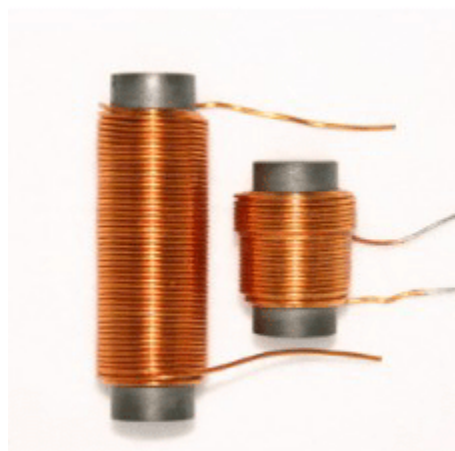
Such materials that are weakly magnetized in the opposite direction of external magnetic field are known as diamagnetic materials.

Diamagnetism is present in all materials but almost negligible. Examples are zinc, copper, mercury, gold, silver etc.

Ferrites

They are also known as ceramic magnetic materials. They are formed by grinding iron oxide and alkaline earth materials (group II A of periodic table) like barium into fine powder. The powder is pressed into different shapes and baked at high temperature. It gives magnetic materials having high relative permeability of 50-3000.

Ceramic magnets are used as gasket latches on fridge doors. Ferrite cores are used for RF transformers up to 20 MHz frequencies.





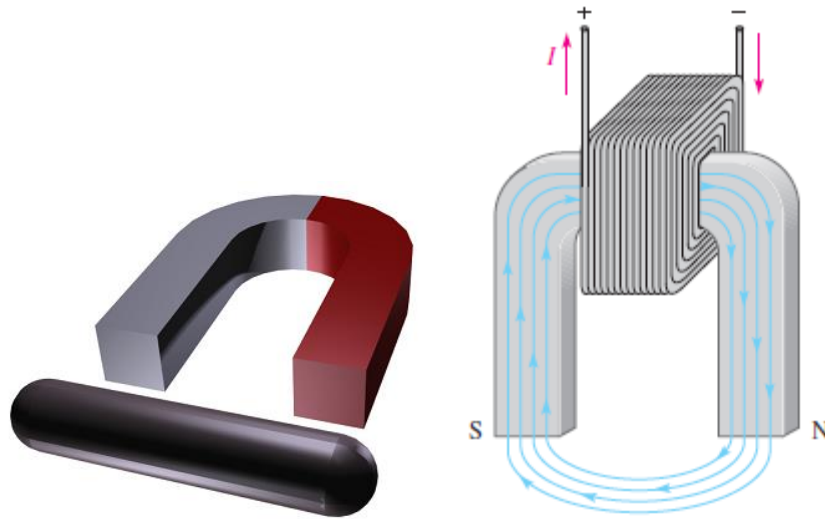
Types of Magnets

Permanent Magnets

They are made of hard magnetic materials like cobalt steel which is magnetized during manufacturing and they maintain their magnetic strength if once magnetized. Other permanent magnetic materials are alnico and permalloy used in loudspeakers, motors etc. They retain their magnetism permanently and do not get exhausted with use.

Electromagnets

They become magnets when current is passed through them and demagnetize when current is switched off. More current and more turns produce stronger magnetic field. A simple electromagnet is coil of wire wound around a core material which can be easily magnetized. Electromagnets are used to hold and lift metal objects, bells and magnetic circuit breakers etc.



Demagnetizing or degaussing

When there is a need to remove magnetism from certain objects demagnetizer is used.

By hammering or beating a permanent magnet at high temperature can demagnetize a magnet.

Such objects can be demagnetised by using a demagnetiser which consists of a multi-turn coil carrying alternating current. When the object to be demagnetised is placed inside the coil, the alignment of its molecular magnets is destroyed by the alternating magnetic field of the demagnetiser.

Magnetic Shielding

To avoid disturbing magnetic field from nearby components, magnetic shielding is used. For example to protect a meter from earth's magnetic field or other unwanted field the meter is surrounded by soft iron core or any other magnetic material. Flux passes easily through the magnetic material than air so causing no disturbance to the meter.

