

FERROMAGNETISM

Ferromagnetic materials possess a very large resultant magnetic moment .

The fundamentals of the theory of ferromagnetism were given by Y.Frenkel and Werner Heisenberg in 1928 .

This theory is called the Domain theory .

According to this theory :

1 The spin magnetic moments of the electrons are responsible for the magnetic properties of ferromagnetics .

2 Under certain exchange forces ,these spin magnetic moments are lined up parallel to one another .

This results in setting up of regions of spontaneous magnetization,which are called **domains** .

3 In each domain ,the atoms have magnetic moments which are aligned strictly in a single direction.

4 A very strong magnetic field appears inside a domain and as a result of this ,it is magnetised to saturation .

A domain contains from 10^{21} to 10^{17} atoms and has a dimensions of the order of 10^{-8} to 10^{-12} m³ .

5 Magnetic moments of different domains have different directions in the absence of external magnetic field and as a result of this ,

the resultant magnetic moment is zero as shown in figure (b)

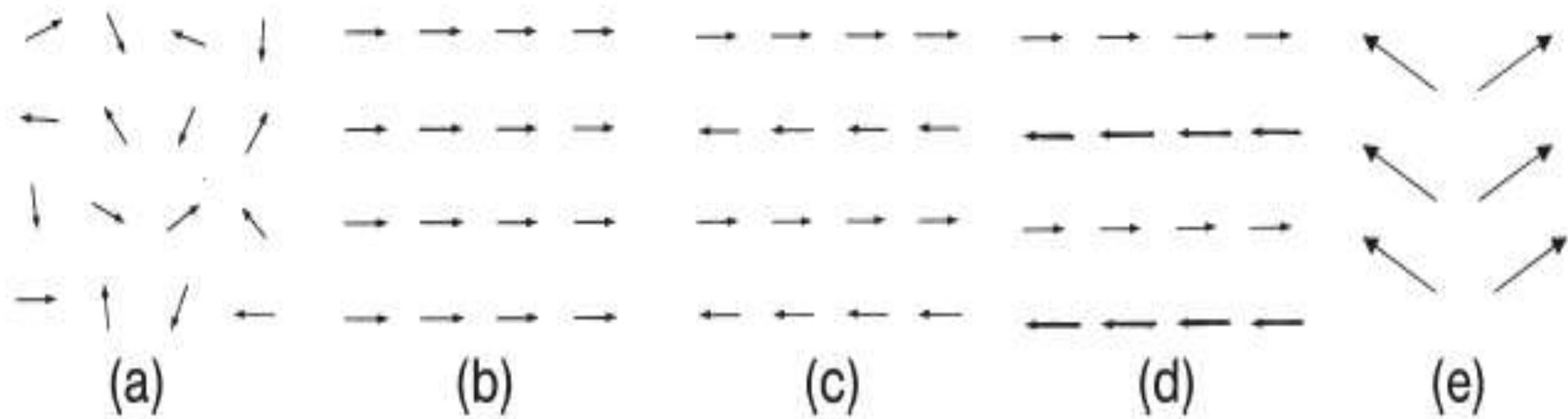


Figure 6 Disordered and ordered states of magnetic moments: (a) paramagnetic; (b) ferromagnetic; (c) antiferromagnetic; (d) ferrimagnetic; and (e) canting antiferromagnetic states.

6 In the presence of an external magnetic field .the domain suffer two effects :

(i) those domains oriented favourably with respect to the magnetic field grow at the expense of those oriented less favourably

figure (b) due to reorientation effect of the magnetic field figure (c)and the piece of matter becomes a magnet .

7 In soft magnetic materials ,the domain boundaries (Block walls) align with magnetic field more easily and as such even weak fields can produce alignment .But in hard specimen , the boundaries are more restricted and stronger fields are needed for magnetization .