Antiferromagnetism

Exchange forces sometimes result in appearance of so called antiferromagnetics

(chromium ,manganese etc)where the intrinsic moments of the electrons are spontaneously oriented

antiparallel to one another .Such an orientation involves adjacent atoms in pairs .The result is that antiferromagnetics have an extremely low magnetic susceptibility .

It behave like very weak paramagnetics.

There is also a tempertature for antferromagnetics at which the antiparallel orientation of the spins vanishes.

This temperature is also known as th antiferromagnetic C**urie point** or the **Neel Point** .

In the case of the antiferromagnetic ordered state, the two sublattices possess their own magnetizations, which are oriented in the opposite direction

and at half the magnitude compared to the ferromagnetic case. However, each magnetization obeys the ferromagnetic spontaneous magnetization curve at half magnitude. Consequently, the net magnetization is almost zero, giving the same order of magnetic susceptibility as the paramagnetic state. The most important difference observed in this ordered state is the anisotropic susceptibilities, $\chi_{//}$ and $\chi_{\perp}$, the parallel axis being defined along the magnetization direction, which is called an “easy axis”.

Therefore, the external magnetic field can be applied along the easy axis

or perpendicular to it and the magnetic susceptibilities, $\chi_{//}$ and $\chi_{\perp}$,

are illustrated schematically

, in which $\chi_{//}$ decreases linearly toward zero on lowering the temperature,

whereas $\chi_{\perp}$ stays constant. A powdered sample usually exhibits their averaged value,

$$\chi = \left(\chi_{\parallel} + 2\chi_{\perp} \right) / 3$$

The most important magnetic behaviors of the antiferromagnets are the magnetic phase change with increasing magnetic field, especially a field applied along the easy axis; that is, the direction of the magnetic moments. The magnetic energy in the parallel arrangement exceeds the assumed energy in the perpendicular arrangement at a certain magnitude of the magnetic field, and the parallel orientation abruptly changes into the perpendicular one, conserving the antiparallel orientation.