CONDUCTIVITY AND MAGNETISM OF MAGNETIC OXIDES

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9.7 cm

In a stoichiometric oxide the magnetism occurs by superexchange which involves the virtual transfer of a d electron from the transition ion to the neighbouring oxygen. When the oxide is doped there are already holes on the oxygen or the transition ion becomes mixed valent. In the mixed compounds conductivity may occur more readily. The electron transfer between the transition metal ions is generally via the oxygen and so similar processes are involved as those which caused the antiferromagnetic superexchange. In this talk the difference is explored between the materials in which there is true antiferromagnetism and those which are ferrimagnetic. In the antiferromagnets the carriers must destroy the magnetic order as they move. This behaviour is well known from the cuprates. In ferrimagnets the carriers may be able to move entirely on one sublattice. This occurs in Fe_3O_4 and probably in the doped garnets. In the case where motion is on one sublattice then doping does not destroy the magnetism and there is a small magnetoresistance. An interesting feature is that unlike the cuprates the ferrimagnets do not become good metals at any doping but exhibit hopping conductivity.

A further interesting case is given by the manganites where the underlying antiferromagnetic structure (Ay) would allow nearest neighbour charge transport in the ferromagnetic planes which would not destroy the antiferromagnetism. This does not occur and the charges move in all three directions, the antiferromagnetism is rapidly quenched and a ferromagnetic metallic phase occurs. We explain the apparent paradox that the best conductivity is actually observed in materials where the conduction is only allowed when the antiferromagnetism has been quenched and that conductivity should not be favoured in ferrimagnets.

13.4 cm

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