Charge transport through ionic clusters of the magnetic oxides

G.A. Gehring[*] A. Lehmann-Szweykowska[**], R.J. Wojciechowski[**], P.E.Wigen[***] and R. Micnas[**]

[*] Department of Physics & Astronomy, University of Sheffield, Sheffield, UK
[**] Inststitute of Physics,A. Mickiewicz University, Poznan, Poland
[***] Department of Phys.,Ohio State University, Columbus, USA

9.7 cm

In order to interpret empirical data related to doped garnets,we analyze the spin-controlled charge transfer through a heterostructure consisting of site-coupled octahedral and tetrahedral iron-oxygen clusters. A number of charge carriers can be manipulated by valence-uncompensated doping, which indirectly tailors also the magnitude and orientation of permanent magnetic moments attached to the clusters. The electron-energy structure of both clusters, involved in the transfer, as well as that of the heterostructure are found within the framework of the Anderson model. Current-voltage characteristics, derived from the Landauer-like formula, turn out to be highly sensitive to the position of the Fermi level of the system. We also calculated the magnetoresistance, which is different for different orientations of the external magnetic field. The result confirmed the empirical data, indicating anisotropy of the magnetoresistance. In the microscopic mechanism of the spin-controlled charge transfer, the key role is played by the inter-band $p-d$ hybridisation. The charge carrier compensating holes tend to remain on the oxygen ions. In the presence of the compensating hole, the antiferrromagnetic order of the spins attached to the clusters, changes its sign. It is an orbital contribution to magnetic moments of the clusters that gives rise to the anisotropy of the magnetoresistance.

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Corresponding author :
R. J. Wojciechowski

Address for correspondence :
Institute of Physics UAM
Solid State Theory Division
ul. Umultowska 85
61-614 Poznań, Poland

Email address :
wojrysz@amu.edu.pl