THEORY OF THE SOLID-STATE PHYSICS ON THE TURN

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The discovery of the high-temperature superconductivity in the copper oxide has revealed the enormous shortage of our general understanding of the 3d-ion compounds. Namely, the insulating state of La_2CuO_4 contradicts the standard band-structure result that predicts it to be metal. This dramatic breakdown of the ordinary band-electron theory has been known already for years for 3d-ion monooxides. Different reparations do not lead to the consistent picture for 3d-ion systems (Mott insulators). At present after announcement of the essential importance of the single-ion effects and many-electron discrete states in description of compounds containing transition-metal atoms of the 3d and 4f groups the fundamental controversy has become the scientific fact.
In the paper the modern solid-state physics theories will be discussed in connection with possibility for description of real systems like $LaMnO_3$, $LaCoO_3$, MgV_2O_4, NiO. It turns out that the remarkably consistent description has been obtained within the individualized-electron theory, that underlines the fact that 3d/4f ions constituting a solid preserve much of their individual quasi-atomic properties. We have found the existence of very strong correlations within the 3d shell that produce the highly-correlated $3d^n$ systems with large orbital magnetism.
It is concluded that for the description of electronic and magnetic properties of real 3d-ion systems the fine electronic structure, resulting from crystal-field, spin-orbit coupling, local lattice distortions (Jahn-Teller effect) has to be taken into account.

9.7 cm

13.4 cm

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