**Nanoscale physics**

**Modified two-pole approximation for systems with strong electron correlations: peculiarities of spectrum and DOS**

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For nanoscale systems theoretical description, the improvement of both analytic and numerical methods of treatment for strong electron correlations in a wide range of electron concentration and energy parameters is instrumental. In a new variant of Hartree-Fock approximation for calculation of electrical and magnetic properties of strongly correlated electron systems in nano-scale material, the quasiparticle energy spectrum is obtained. The spectrum is temperature- and concentration-dependent, exact in atomic and band limits and gives a consistent description of the metal-insulator transition at temperature change or under the external pressure application. Refinement if the initial approach [1] has allowed us to take into account the energy states widening which caused an essential transformation of the electron density of energy states. The single-particle Green function is calculated analytically and model DOS features are discussed in detail for various values of energy parameters of the model and applied for investigation of low-temperature antiferromagnetic phase and possible phase transitions under the external influences. We show that the transitions on-site level – Hubbard subband widen atomic levels instead of shifting them, here an analogy to single-impurity Anderson model [2,3] and dynamic mean-field theory can be found.

The electron-hole asymmetry in the model reflects a peculiar behaviour of specific nanomaterials, generalizing the Hubbard model and *t-J* model. Hopping integrals are renormalized by electron correlations and appear to be concentration-dependent. As a consequence, at change of conductance type the bandwidth, activation energy and conductivity are found to undergo sharp changes.

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