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On the Nature of Superconductivity Phenomenon: New Sight and Simple Explanation

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Abstract

The explanation of the nature of superconductivity phenomenon which is based on the postulate of the possibility of existence of the giant molecule with uniprobable localization of the bound valence electrons on all atomic remains is proposed. A way of the experimental testing of considered model is shown.
Keywords: Superconductivity; Gimole; Macrobody

Introduction

All existing at present interpretations of superconductivity phenomenon are based anyhow on the idea of the charge transfer by free carriers. The exotic conditions of the nondissipative transfer are sought in all cases. But it is possible to explain this phenomenon more simply: by collectivization of the bound valence electrons in a macrobody.

In the limits of the explanation proposed by us we postulate the possibility of existence of such state of solid when the valence electrons being in the stationary energy state get common for all ensemble of atomic remains forming the solid. In other words, we postulate the possibility of existence of the giant molecule (gimole) with uniprobable localization of the bound valence electrons on all atomic remains (i.e. the wave function of each of these electrons is distributed quasiuniform in all space of gimole) [1]. That corresponds to the N-multiple exchange degeneracy of the energy levels where N is the atomic remains' number in gimole.

Proposed model resembles the Thomson atomic model ("pudding with raisins") in which the electrons are embedded to the positive-charge cloud. There is a special embedding of collectivized bound valence electrons to the atomic remains' "cloud" in our case.

It is naturally to consider that the conductivity, with the aid of collectivized bound valence electrons being in the stationary states, of this giant molecule is infinite as, for example, "the electron orbit conductivity" in ordinary atom or simple molecule is infinite a priori.

This is the generally accepted idea that the bound valence electron's transitions between neighbouring atoms are possible only by means of the local and accidental tunneling through the potential barrier. Such transitions cannot cause the through channel of the bound valence electron's exchange in the solid. However, let us consider the hypothetical variant of the interatomic potential barrier with a due account of its dynamics supposing that the kinetic energy of the bound valence electrons for a certain temperature is just rather insignificant but still exceeds a top amplitude value of the potential barrier height as it is shown in Fig. 1,b. Then such channel becomes possible and the solid turns into the gimole state. If, however, the top amplitude value of the potential barrier height is taller than the value of kinetic energy of indicated electrons that the formation of such channel (if only even short-lived) becomes nonprobable practically owing to noninphasing of thermal vibration of the lattice atoms as in the case of the local tunneling (see Figure 1,a). There is the same situation in the case of the considerable spatial atoms' dissociation. Figure 1 is the schematical illustration of above-stated reasons. Here, apart from the accepted conventional signs of the zones, T_{cr} is a temperature of origin of the superconductive channel, n_{sp} are the zones connected genetically with s- and p-levels of the outermost n-shell's atoms, the arrows indicate the vibrational character of atom motion and, accordingly, the potential barrier modulation.

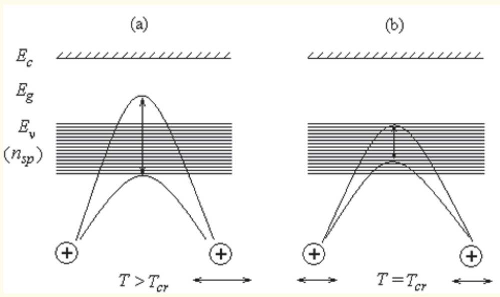

Figure 1: Schematical illustration of the formation of the superconductivity channel:
(a) Channel is wanting and (b) Channel takes a place; full curves indicate the sum of the potentials of the neighbouring atoms.

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It can be indicate two ways of decrease of the thermal vibrations of the lattice's atoms which are a cause of the temperature limitation of superconductivity in our model. The former is obvious, it is the temperature decreasing, and the second way is the matrix filling by the small size atoms which could undertake material part of vibration energy and would be conductive to decrease of the potential barriers being in it way the bridges between the matrix's atoms. The first way leads to arising of the superconducting state in the elementary substances, for example, in metals when the temperature is close to absolute zero. The second way leads to the transition of the more compound multicomponent substances, specifically compound ceramics to the superconducting state with the far higher temperatures.

The sufficient approach of atoms is the necessary condition of existence of the gimole. That is why heavy atoms with incomplete inner shells (heavy transition elements) having the small outlying electron density are the most suitable. As the filler-atoms it should be prefer the atoms having the least size, for example, the oxygen atoms.

The electron density distribution in gimole doesn't differ essentially from its distribution in the solid when it is in usual state.

The proposed model rules out the possibility of the charge transfer by free electrons because it is impossible to create the macrogradient of the electric field potential in gimole. The mechanism of the charge transfer by free carrier determining the conductivity with the temperatures being higher than critical ones is turned off on reaching the critical temperature of the transition to the superconducting state.

Apparently, it is of great interest to make experiment on the damping of the superconductivity by electromagnetic radiation with the quantum's energy corresponding to the energy gap between upper valence state and free zone. The damping effect must be in connection with the activation of the bound valence electrons and, consequently, the temporary exclusion of them from the mechanism of the charges nondissipative transfer.

Conclusion

Thus, we propose the explanation of nature of superconductivity phenomenon which is based on the postulate of possibility of existence of the gimole with uniprobable localization of the bound valence electrons on all atomic remains, without drawing of the idea of charge transfer by free carriers which requires inventing of various exotic conditions for realization of the nondissipative transfer.

It should be note that the whole of the macrobody must be not necessarily giant molecule for the superconductivity realization. It is enough that it has the fragments ensuring the through channels of the charge transfer by the bound valence electrons.

We touched not upon the problems of the heat transfer, optical and magnetic aspects of the problem here, and let us only note that, with the first consideration of connection of these phenomena with proposed interpretation of the superconductivity phenomenon, you cannot see the vital factors which could contradict gravely it.

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