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A model of the conductivity of composite materials

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The aim of the work is to investigate the dependence of resistance on temperature for composite materials with a dielectric matrix and conductive filler. The problem of using these materials is the not fully investigated nature of the conductivity from temperature.
The paper calculates the dependence of the resistance for a composite material with a dielectric matrix and a conductive filler on the temperature using various methods: the WKB approximation, the estimation through the coefficient of passage of a particle in a rectangular potential barrier. The obtained results were based on the quantum mechanical theory of tunneling. But the currently available models cannot fully describe these dependencies.
A qualitative model is proposed that describes the dependence of the resistance of a composite material taking into account various parameters: the coefficient of linear expansion, the difference between the energy of the particle and the energy of the potential barrier, the particle size, the distance between the particles. The qualitative dependences of the resistance of the composite material on the temperature when these characteristics change are presented. It is established that when the coefficient of linear expansion of the matrix decreases (for example, when replacing a substance in a composite), the resistance value decreases. As the distance between the composite particles increases, the sample resistance also increases.
The obtained results can be used to create a unified model describing the nature of the change in the resistance of a composite material with a change in temperature.

Keywords. Percolation theory, tunnel effect, potential barrier, dependence of the resistance of a composite material on temperature, WKB approximation.

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