**Nanocomposites and nanomaterials**

**Structurally dependent electroconductivity properties of ultrafine composites α-FeOOH/α-Fe2O3**

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The method of hydrothermal synthesis of ultrafine composite material defective α-FeOOH/defective α-Fe2O3 is implemented and the mechanism of its phase for­mation is analyzed. It is revealed that due to the control of synthesis time and tem­perature the processes of high-temperature hydrolysis are initiated with the subse­quent nucleation of iron hydroxide nuclei and the formation of a defective three- dimensional xerogel network. The influence of material post-processing temperature on phase transformations, change of magnetic microstructure and electrically con­ductive properties is traced. Two temperature ranges of phase and structural stability of the composite were revealed. Up to a temperature of 150oC there is a preservation of two components of the composite defective α-FeOOH and defective α-Fe2O3, which are in a magnetically ordered state and there is a partial recrystallization of ultrafine composite. At a temperature of 250oC completes the phase transition α-FeOOH→α-Fe2O3, which is reflected in the change in the mag­netic microstructure of the material: the magnetically ordered component is repre­sented by only Zeeman sextets corresponding to crystalline and defect crystal structures α-Fe2O3.

The influence of phase and structural transformations of the formed ultra-dispersed composites on the manifestation of their electrically conductive properties is established. In particular, the structural organization of the ultrafine defective composite α-FeOOH/α-Fe2O3 provides the implementation of the proton conduction mechanism. Conduction in the polymer chains of the hydroxide phase is due to surface percolation of the charge, the initialization of which occurs immediately at low frequencies. Conductivity within hematite agglomerates is realized by capacitive and resistive mechanisms due to free charge carriers. Increasing the frequency of the external electric field causes the formation of free charge carriers within the polymer hydroxide network, as a result of which the conductivity at direct current is realized through both components of the composite.