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Migration of oxygen in superconducting $YBa_2Cu_3O_{7-x}$ under various conditions

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The problem of oxygen non-stoichiometry is common for all high-temperature superconductors and is connected with the mixed valence of the metallic atoms, particularly with that of copper, which has a prominent role for the superconducting properties of these materials. At present, the procedure for obtaining high-temperature superconductive articles by the method of laser ablation is developed quite actively. The service properties of the articles obtained by this method depend rather strongly on the oxygen content in the initial target. Thus, it is extremely important to use experimental methods that make it possible to obtain information on the oxygen content in the material in different temperature ranges.

In this work processes connected with the migration of oxygen in high-temperature superconductive ceramics was studied by thermogravimetric analysis and double iodometric titration. Specimens were targets for the laser ablation of composition YBa2Cu3O7-x with different oxygen content. Investigations were carried out under polytermic and isothermal conditions at a wide temperature range (from room temperature to 900 °C) in various environments (vacuum and atmospheric air). The results of thermogravimetric analysis, sensitive to the overall change in the content of oxygen in the sample, do not match with the results of the iodometric titration, sensitive to changes in oxygen content directly into the crystal lattice. The discrepancy between the results obtained by these methods is observed for all samples under all measurement conditions. Processing data obtained during isothermal annealing, shows that the occurring processes can not be characterized by one diffusion constant. The observed results can be explained by the migration of oxygen in different structural positions, namely, the interstices and pores of the sample and directly sites of the crystal lattice.

Keywords: high-temperature superconductivity; oxygen diffusion; oxygen stoichiometry; thermogravimetric analysis; iodometric titration