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Effect of nanosecond electropulse effects on the properties of the alloy Cu-1.75% Cr

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Abstract

The hardness, electrical resistance, deformation resistance of the Cu-1.75%Cr alloy obtained by irradiating its melt at a temperature of one thousand three hundred and fifty degrees Celsius by nanosecond unipolar electrical pulses of one thousand Hertz, a single signal duration of one nanosecond and ten kilowatts were experimentally determined. The dependences of the determined properties of the metal on the duration of the electric pulse irradiation are established. A comparison was made between irradiated and unirradiated, but obtained under the same thermal and temporal conditions, alloy samples. An improvement was observed in both mechanical (increase in hardness up to eight percent) and electrical (decrease in electrical resistance to fourteen and a half percent) characteristics due to electric pulse effect on the melt. It was found that the best time for electropulse treatment is from five to ten minutes. It is shown that the effect of irradiation of the Cu-1.75%Cr melt on the electrical resistance of the resulting alloy and its hardness differs from the results of irradiation of the Cu-1%Cr melt, but retains the same tendencies in changing properties. A significant difference was found in the hardness values of unirradiated samples of Cu-1.75%Cr and Cu-1%Cr alloys. A model of the connection of electrical resistance and hardness of Cu-Cr alloys with the redistribution of chromium in their volume is proposed. The results of melt processing by nanosecond unipolar electric pulses are presented in the form of microstructure snapshots, tables, and mathematical formulas. On the basis of the obtained results, it was concluded that the proposed model is useful for assessing the quality of Cu-Cr system alloys from the standpoint of increasing their hardness and decreasing electrical resistance, including after electropulse treatment of the corresponding melts.

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