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Influence of Al and Cu microadditions on the mechanical properties of the amorphous alloys of the Fe-Ni-Cr-P-Si-B system

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The study of Al and Cu (0.5%-2.0%, at. fraction) microadditions influence on the mechanic cal properties of the amorphous alloys has been done on the example of the $Fe_{60}Ni_{10}Cr_{10}P_{14}Si_4B_2$ and the $Fe_{70}Ni_{15}Cr_{10}P_{15}$ alloys which allowed to define the influence of Al and Cu in the system with a full set of metalloids and in the system with only a single metalloid. Both alloys in their initial state were non-ductile and showed a tendency to brittle failure to a different degree. Addition of Al to the alloy composition has resulted in the qualitative change of the mechanical properties of the alloys in both systems. This effect is clearly marked in the Fe-Ni-Cr-P system where addition of Al allows obtaining the ductile high strength tape with a quality surface. Addition of 0.5%(at. fraction) Cu to this system has resulted in the sharp reduction of the tape thickness and some diminution of the sample strength. Probably it is connected to the formation of through defects in the tape samples of a small thickness. Addition of an Al to the Fe-Ni-Cr-P-Si system has resulted in the increasing of alloy's ductility, the strength growth and the high quality surface as well. Introduction of 0.5%(at. fraction) Cu in addition to Al has resulted in the growth of the values of temperature tempering brittleness and plasticity, as well as some reduction in strength.

Layer-by-layer analysis of the chemical composition has been done by the Auger electron spectroscopy method to reveal the reasons of Al influence on the mechanical properties of the amorphous alloys. Analysis of Auger spectra has defined that Al behaves as surface active element forming oxygen compounds to the 10 nm depth on the free surface of the tape samples. A narrow range (from 10 nm to 20 nm) of some saturation with Ni atoms has been noticed for the alloy with the addition of 1%(at. fraction) of Al. The similar pattern of elements distribution is characteristic of the alloy containing 1%(at. fraction) Al and 0.5%(at. fraction) Cu but in a smoothed form.

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