ABSTRACT

This study presents the results of investigations conducted on rapidly solidified alloys produced via the method of continuous casting of molten material onto a rotating copper roller. The resulting samples were obtained in the form of thin ribbons with a thickness of approximately 35 μm. The primary objectives of the research were the fabrication of the samples, the design of an isothermal annealing process, and the examination of both structural and magnetic properties. The alloys studied had the following chemical compositions: $Fe_{65}Co_{11}Zr_2Hf_2B_{20}$, $Fe_{65}Co_{10.75}Zr_2Hf_2B_{20}Si_{0.25}$, $Fe_{65}Co_{10.50}Zr_2Hf_2B_{20}Si_{0.50}$, $Fe_{65}Co_{10.25}Zr_2Hf_2B_{20}Si_{0.75}$, $Fe_{65}Co_{10}Zr_2Hf_2B_{20}Si_1$, $Fe_{65}Co_{9.75}Zr_2Hf_2B_{20}Si_{1.25}$, $Fe_{65}Co_{9.5}Zr_2Hf_2B_{20}Si_{1.5}$. In these alloys, a partial substitution of silicon for cobalt was introduced in order to deliberately induce structural disorder within the magnetic matrix. Additionally, further structural modifications were achieved through a carefully designed isothermal annealing process, which was developed based on the analysis of the temperature dependence of the magnetic saturation polarization. The annealing was performed at a temperature above the Curie point, where the material transitions to a paramagnetic state, and maintained for 30 minutes. Structural and magnetic property analyses revealed that the applied thermal treatment effectively reduced internal stresses in the material and significantly enhanced its magnetic performance — particularly by lowering coercivity and increasing saturation magnetization. Notably, two distinct Curie temperatures were identified for the studied alloys. Moreover, post-annealing X-ray diffraction patterns showed the appearance of peaks in the 2θ range for alloys with higher silicon content, indicating structural changes.

The research, conducted as part of a doctoral dissertation, focuses on the development of novel amorphous alloys. It demonstrates that a properly optimized isothermal annealing process can significantly improve the magnetic properties of these materials while preserving their amorphous character.