Structural and Magnetic Properties of Nanocrystalline FeSiBPCu Alloy

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Abstract. Structure and magnetic properties of the as-cast and nanocrystalline NANOMET-type soft magnetic alloys of two different compositions differing in silicon content, i.e. $Fe_{82}Si_4B_{10}P_3Cu_1$ and $Fe_{78}Si_8B_{10}P_3Cu_1$, were studied. Nanocrystalline samples were prepared from amorphous precursors by heating at 420°C during 20 and 60 minutes in Ar atmosphere. The effect of the silicon content and the annealing time on alloy properties was investigated by Mössbauer spectroscopy, magnetic measurements and by atomic force microscopy (AFM). Mössbauer spectroscopy disclosed especially effect of the silicon content on the microstructure after annealing, i.e., the lower relative volumetric fraction of the crystalline component for the $Fe_{78}Si_8B_{10}P_3Cu_1$ alloy. Magnetic measurements indicated that the longer annealing time is reflected in the resulting coercivity H_c. Better soft magnetic properties showed sample with 8% of Si after annealing for 20 minutes whose coercivity was lower as well as the determined magnetization work W. The AFM measurements of the sample surfaces manifested the differences between samples of different compositions and annealing times. The height of the individual grains on the surface of the $Fe_{82}Si_4B_{10}P_3Cu_1$ sample did not change with increasing annealing time, however, the number of grain agglomerates has increased. In the $Fe_{78}Si_8B_{10}P_3Cu_1$ sample, the grains and agglomerates continued to grow after 20 minutes of annealing.