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THE PRECIPITATION OF NANOCRYSTALLINE STRUCTURE IN THE JOULE HEATED $Fe_{72}Al_5Ga_2P_{11}C_6B_4$ METALLIC GLASSES

N. Mitrović[*,#], S. Kane[**], S. Roth[***], A. Kalezić-Glišović[*], C. Mickel[***], J. Eckert[***]

[*]Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Materials, University of Kragujevac, Technical Faculty Čačak, Svetog Save 65, 32 000 Čačak, Serbia,
[**]School of Physics, D. A. University, Indore-452017, India,
[***]Leibniz Institute for Metallic Materials, IFW Dresden, P.O.Box 270016, D-01171 Dresden, Germany

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Abstract

In this study, the evolution of the nanostructure on dc Joule heated $Fe_{72}Al_5Ga_2P_{11}C_6B_4$ metallic glass ribbons have been investigated. Heating power per square area (P_S) was ranging between 0.8 to 7.1 W/cm^2 in order to get various stages of relaxation or nanocrystallization. The crystallization starts after applying $P_S \approx$ 4.35 W/cm^2 and the sample consist of residual amorphous matrix, a magnetic crystalline component and also a non-magnetic crystalline component (relative abundance of Fe in the crystalline phase is about 35 %). XRD measurements show that crystalline samples after current annealing consist of Fe_3B, FeC, FeP and Fe_3P compounds. On TEM micrograph a broad distribution of shapes and sizes is noticed, the latter range from about 60 to 350 nm, increasing by applied heating power. The decrease of the electrical resistivity after each current annealing treatment is rather small in comparison with other Fe-based amorphous alloys (only about 1.5 % for the highest P_S). Partial nanocrystallization leads to increase of coercive field (from $H_C \approx$ 7 A/m in the amorphous as-cast state up to 45 A/m) attributed to precipitation of magnetically harder compounds (Fe_3B and FeC).

Key words: *Metallic glasses, Thermal properties, Nanocrystallization, Transmission electron microscopy, Mössbauer spectra, Electrical measurements, Magnetic measurements.*

[#] *Corresponding author: nmitrov@tfc.kg.ac.rs*

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