Amorphous alloys in X-ray light: insights from ultrafast Joule heating experiments

J. Bednarčík,[1,2]

[1]*Pavol Jozef Šafárik University in Košice, Faculty of Science, Institute of Physics, Park Angelinum 9, 040 01 Košice, Slovakia*
[2]*Slovak Academy of Science, Institute of Experimental Physics, Watsonova 47, 040 01 Košice, Slovakia*

Metallic glasses prepared by rapid quenching method represent unique class of soft magnetic materials with excellent magnetic properties such as relatively high saturation of magnetic induction, high permeability combined with low magnetostriction, coercivity and magnetization loss. In course of designing new materials with improved magnetic properties it is important to understand relationships between structural (atomic) modifications and their macroscopic (magnetic) characteristics. Time-resolved in-situ X-ray diffraction experiments performed at high-brilliance synchrotron radiation sources can detect tiny changes of the amorphous structure when exposed to a variety of temperature–pressure conditions. In this talk a novel setup for studying rapid crystallization of metallic glasses using a time resolved in-situ X-ray diffraction combined with a direct current fast Joule heating (flash-annealing) is presented. Its potential use is demonstrated by studying rapid crystallization of soft magnetic $Fe_{73.5}Cu_1Nb_3Si_{15.5}B_7$ (at. %) metallic glass prepared by melt spinning technique. Results show that a single rectangular current pulse with a fixed amplitude of 1.5 A and pulse duration of 50 ms causes temperature to rise to 1020 °C with an average heating rate of 5600 K/s.