ESRF	**Experiment title:** **Effect of in-field annealing on magnetic microstructure of nanocrystalline alloys**	**Experiment number**: MA-872
Beamline: ID-22N	**Date of experiment**: from: 02/12/09 to: 08/12/09	**Date of report**: 03/07/15
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Report:

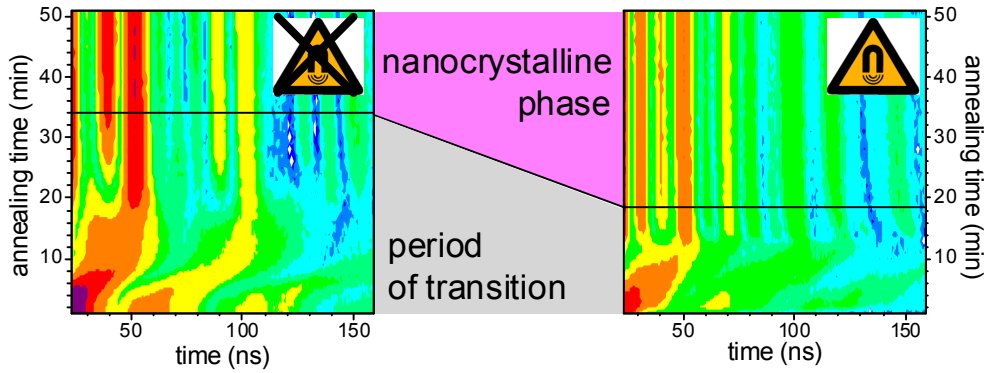
Results obtained during this experiment were in the mean time published in two papers:

1. Miglierini M., Procházka V., Rüffer R. and Zbořil R.: *In situ crystallization of metallic glasses during magnetic annealing*, Acta Mater **91** (2015) 50-56. (DOI: 10.1016/j.actamat.2015.03.012)

Abstract:

The impact of external magnetic field upon changes in the crystallization kinetics of $Fe_{90}Zr_7B_3$ metallic glass is studied by *in situ* nuclear forward scattering (NFS) of synchrotron radiation. Structural and magnetic information on the whole process of nanograin formation is monitored on fly in real time by means of time domain Mössbauer effect technique. Isothermal annealing performed at 753 K under weak magnetic field (B_{ext} = 0.652 T) exhibits more rapid crystallization in comparison with zero-field conditions. These surprising effects of external magnetic field upon the process of phase transformation are attributed to energetic perturbations of magnetic interactions in comparison with the thermal energy. Consequently, the formation of nucleation centers is enhanced. Such accelerated crystallization was not reported so far for metallic glasses exposed to magnetic field *during* annealing. The influence of magnetic field on the resulting properties is usually assessed under static conditions *after* the annealing. The use of NFS with rapid data acquisition has allowed *in situ* observation of the microstructure development throughout the fast annealing processes. In this way, not only the starting and the final stages of the structure can be characterized but also the intermediate transition period states of the transformation can be followed to fine details.

Graphical abstract: Contour plots of NFS taken from isothermally annealed (@ 753 K) $Fe_{90}Zr_7B_3$ metallic glass without (left) and with (right) external magnetic field (0.652 T).



2. Procházka V., Vrba V., Smrčka D., Rüffer R., Matúš P., Mašláň M. and Miglierini M.: *Structural transformation of NANOPERM-type metallic glasses followed in situ by synchrotron radiation during thermal annealing in external magnetic field*, J. Alloy. Compounds **638** (2015) 398–404 (DOI: 10.1016/j.jallcom.2015.03.058).

Abstract:

Kinetics of the crystallization process of Fe-Mo-Cu-B-type metallic glass is studied to fine details during heat treatment under external magnetic field. Structural arrangement as well as magnetic microstructure is followed on-fly using sophisticated method of *in situ* nuclear forward scattering of synchrotron radiation. The onset of crystallization starts earlier when low magnetic field (0.652 T) is applied. Not only is the onset of the crystallization accelerated but the final state of the annealed alloy is also affected by the applied weak external magnetic field.

Graphical abstract: Contour plots of NFS taken from dynamically annealed $Fe_{81}Mo_8Cu_1B_{10}$ metallic glass without (left) and with (right) external magnetic field (0.652 T).