Fellow: Dr. Vasily Milyutin

Title: Development of technology for the manufacture of FeGa-based alloys for high-frequency applications

Host organisation: Institute of Material Research SAS

Duration of the project:
15. 10. 2020 – 14. 10. 2023

Bio:

30 years old; married; nationality: Russian; languages: Russian, English, Slovak (beginner). Field of interest: soft magnetic materials, features of their structure formation, structure-properties relation.

Career:

2008 – 2013, Ural Federal University named after the first president of Russia B.N. Yeltsin, metallurgical faculty. Specialty is materials science in engineering.

2013 – 2017, Institute of Metal Physics (Ekaterinburg, Russia), PhD courses, Condensed Matter Physics.

2017 – 2019, Institute of Metal Physics (Ekaterinburg, Russia), scientist, division of ferromagnetic materials.

2019 – 2020, Institute of Metal Physics (Ekaterinburg, Russia), senior scientist, division of ferromagnetic materials.

2020 – present time, Institute of Materials Research (Kosice, Slovakia), scientist, division of functional and hybrid systems.

Grants and awards:

2013 – Grant of RFBR (Russian Fond for Basic Research) No. 14-02-31143.

2014 – Support from EMFL (European Magnetic Field Laboratory) No. GMA06-213 for carrying out experiments at the National High Magnetic Fields Laboratory (Grenoble, France).

2018 – Award for the best scientific publication in journal Letters on Materials (ISSN 2218-5046).

2018 – Grant of RFBR (Russian Fond for Basic Research) No. 18-03-00623.

2019 – Support from EMFL (European Magnetic Field Laboratory) No. GSO01-218 for carrying out experiments at the National High Magnetic Fields Laboratory (Grenoble, France).

2020 – MoRePro programme No. 19MRP0061.

Abstract:

The iron-gallium alloy has the great prospect of widespread use in industry, as a material for the production of modern smart systems, including those operating at elevated temperatures, mechanical loads, and high frequency magnetization fields. This is due to the number of unique functional characteristics, namely, large tetragonal magnetostriction in small magnetic fields, weak hysteresis, high Curie temperature and weak dependence of properties on temperature, moreover, this alloy has relatively good mechanical properties, which makes it possible to produce thin sheets from it for use in high-frequency devices, such as ultrasound transducers and dispersants. For this purpose, it is necessary to create a given crystallographic texture and microstructure by selecting the optimal modes of rolling and annealing, which is impossible without comprehensive studies of the patterns of structural evolution in this alloy. Despite the good mechanical properties compared to, for example, Terfenol-D, the problem of FeGa binary alloy is low plasticity, which can lead to cracking during rolling, which makes it difficult to manufacture sheets of this alloy in industrial conditions. The first way to solve this problem in the project is small additions of alloying elements, which lead to a significant increase in plasticity. We will study the processes of structure and crystallographic texture formation in double and doped alloys, their correlation with the modes of thermomechanical processing, the establishment of the physical causes of such a correlation. The second way is use of new achievements of powder metallurgy for FeGa compaction. This will significantly reduce magnetic loses without the need for thin sheet, but at the same time reduce magnetostriction, our task is find a balance. The purpouse of the project is comprehensive study of the structure formation processes in the FeGa alloy under different conditions and the development of optimal fabrication regimes.