Contribution ID: **1269** Type: **Oral**

STRUCTURES AND PHASE TRANSITIONS IN TERNARY Fe-BASED ALLOYS

Wednesday 1 November 2023 14:50 (15 minutes)

The discovery of an increase in the magnetostriction of α-Fe with partial substitution of iron with gallium [1] has led to a significant amount of research, where a similar effect was sought in various binary (Fe-Al, Fe-Ge, Fe-Si, etc.) and ternary (Fe-Ga-Al, Fe-Ga-Ge, etc.) iron-based alloys. Currently, there is a considerable number of studies on the structure and properties of Fe-Ga alloys (enhanced magnetostriction) and Fe-Al alloys (improved mechanical properties) [2]. However, structural studies on ternary Fe-Ga-Al alloys (promising in terms of a combination of mechanical and magnetic properties) are practically absent. Another interesting structural topic is the investigation of the influence of rare earth elements (RE), such as Tb, Dy, Ce, Y, Er, Pr, Sm, La, on the characteristics of Fe-Ga alloys. The physical and technical properties of these functional materials largely depend on their specific atomic structure, the volume fraction of various structural phases, and their microstructural state.

In this work, research on the evolution of structural phases and the microstructural as-cast state of compositions Fe100−(x+y)GaxAly in the range 17 ≤ (x + y) ≤ 39 at.% [3] and Fe100-(x+y)GaxREy, (with x = 27.4% and 26.7%), where rare earth elements Er (y = 0.5% and 0.2%) and Yb (y = 0.5% and 0.24%) were used, is presented. The results were obtained through neutron diffraction experiments conducted with high resolution and in continuous temperature scanning mode, heating up to ~900℃ and subsequent cooling. Information about the microstructural state was obtained through analysis using the Williamson-Hall method and the method for determining grain size and its distribution along the diffraction line profile [4].

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Session Classification: Condensed Matter Physics

Track Classification: Condensed Matter Physics