7.5.1 RDF ANALYSIS OF AMORPHOUS IRON-BORON-RARE EARTH ALLOYS. By Peter D’Antonio, Badri N. Das and Norman C. Koon, Naval Research Laboratory, Washington, D. C. 20375, U.S.A.

(Fe₈₆B₁₄)₀.₉₅G₀.₀₅LaO.₀₅ alloys, containing many of the rare-earth elements (R), have been produced in the amorphous state by melt quenching. As cast they have an intrinsic coercive force of 2 Oe, which increases rapidly to 9 Oe upon annealing at 650° C. The high coercive force of the crystallized alloy results from a mixture of a-Fe₂₃ and Fe₇B₈ phases with a fine grained microstructure. We have examined three of these amorphous alloys (R=Y, Tb and Er) and amorphous Fe₈₆B₁₄, using x-ray diffraction with Ag radiation. Data were collected in transmission from three stacked 25 micron ribbons, and corrected for absorption. The diffraction data were analyzed with the RAIIDS radial distribution least-squares program to characterize both the short and long range structural ordering present. The experimental RDFs (shown in the figure) were compared with theoretical RDFs obtained from spherical regions of the Fe₇B structure (Fe₇P structure type) and the Tb₆Fe₂₃ structure. Because the scattering from boron is relatively weak, appropriate Fe-Fe and Fe-R RDFs can be determined by weighted differences between the Tb₆Fe₂₃ and Y RDFs. The Tb₆Fe₂₃ difference curve essentially represents all Fe-R distances while the Tb-W₁Y curve is composed of essentially all Fe-Fe contributors. These differences reveal that the Fe topology in Fe₇B₁₄ and (Fe₈₆B₁₄)₀.₉₅G₀.₀₅LaO.₀₅ is very similar to that in Fe₇P (inner region of top three curves) and the short range Fe-R environment is similar to that in Tb₆Fe₂₃ (lower two curves), even in the amorphous state. EP has the smallest metallic radius in the series and a decrease in the Fe-R distance can be seen in the figure. Incorporation of the different rare-earth elements is an isomorphic replacement, since the RDFs have essentially the same shape.

7.5.2 ON THE CRYSTALLIZATION OF FeₓP GLASSES. By E. Hiltunen and M. Tamminen Department of Physical Sciences, University of Turku, Finland.

Crystallization kinetics and the sequence of crystallizing phases of FeₓP metallic glasses were studied during isothermal annealings. In energy dispersive x-ray diffraction (EDXD) measurements the diffractometer is kept at a constant geometry and the whole spectrum is measured simultaneously. When Anton Paar high temperature attachment is used the isothermal annealings can be carried out without moving the sample. This technique renders it possible to follow and analyze the crystallization practically continuously. Because a measured spectrum is an average over a period used for the measurement, it is necessary to fit in the annealing time with the annealing temperature. The amorphous samples containing 18.9 at % phosphorus were prepared by electrodeposition.

During the heat treatments only the stable a-Fe and Fe₇P phases were formed. At temperatures higher than 590 K the crystallization of a-Fe started before the crystallization of Fe₇P phase, but at lower temperatures no time difference was noticed.

The crystallization kinetics of both observed phases were studied calculating the integrated intensities of appropriate diffraction lines growing during the annealing. Intensities were normalized using the total integrated intensities of the spectra and the final stage, heat treated at an elevated temperature, was chosen to be the reference stage. The crystallization was noticed to obey a J law and to be diffusion controlled. As figure 1. shows the average of the calculated Avrami exponents for a-Fe are between 1.1-1.2. At the very beginning of the crystallization the values of the Avrami exponents for a-Fe are a little bit higher (1.7 and 2.1) indicating nucleation. Also at the temperatures higher than 590 K, the exponents are slightly greater than at the lower temperatures.

![Figure 1](image-url) Crystallization kinetics of a-Fe and Fe₇P phases during isothermal annealings at different temperatures between 560 K and 620 K.

Acknowledgements

The authors thank Dr L. Takács and the Central Research Institute for Physics of Hungarian Academy of Sciences for providing us with FeₓP samples and for many helpful discussions.