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ACCEPTED MANUSCRIPT

Anelasticity of the Fe-Ga alloys in the range of Zener relaxation

Séverine A.E. Boyer[1, 2,*], Michel Gerland[2], André Rivière[2], Joan Cifre[3], Valeria V. Palacheva[4], Anastasia V. Mikhaylovskaya[4], Igor S. Golovin[4*]

[1] MINES ParisTech, PSL - Research University, Centre for Material Forming, UMR CNRS 7635, 1 Rue Claude Daunesse, 06904 Sophia Antipolis, France
[2] PPRIME Institute, ISAE- ENSMA, UPR CNRS 3346, Department of Physics and Mechanics of Materials, 1 Av. Clément Ader, 86961 Futuroscope Chasseneuil Cedex, France
[3] Universitat de les Illes Balears, Ctra. deValldemossa, km.7.5, E-07122 Palma de Mallorca, Spain
[4] National University of Science and Technology "MISIS", Leninsky ave. 4, 119049 Moscow, Russia

ABSTRACT

Zener type relaxation in Fe-Ga based alloys with Ga content from ~8 and ~28 at.% were identified and studied using the *Dynamical Mechanical Analyser* (DMA) and a *Forced Torsion Pendulum* (FTP). The Zener relaxation caused by reorientation of pairs of Ga atoms in Fe was used to evaluate the activation parameters of Ga atom jumps in Fe. An increase in the relaxation strength occurred with an increase in the Ga content up to 19 at.% according to an increase in the number of Ga-Ga atom pairs ($\Delta \sim C_{Ga}^2(1-C_{Ga})^2$), whereas a decrease in the relaxation strength from 19 to 28 at.% Ga was assigned to $D0_3$ and $L1_2$ ordering of Ga atoms in Fe-Ga alloys. Ordering and phase transitions in these alloys affected the Zener relaxation parameters and led to the appearance of transient anelastic effects. A study of several ternary Fe-Ga-Al alloys using both temperature dependent and isothermal mechanical spectroscopy (frequency variations from 10^{-4} to 10^2 Hz) was conducted to avoid transient effects which take place at heating or cooling, and to measure anelasticity of alloys in the equilibrium state for the chosen temperatures. The Arrhenius treatment of relaxation effects in single- and poly-crystals allows identifying the Zener effects in ternary alloys and to analyse them with respect to alloy structures.

Key words
Fe-Ga and Fe-Ga-Al alloys, Zener relaxation, Internal friction

[*] Corresponding authors: severine.boyer@mines-paristect.fr (Boyer) and i.golovin@misis.ru (Golovin)

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