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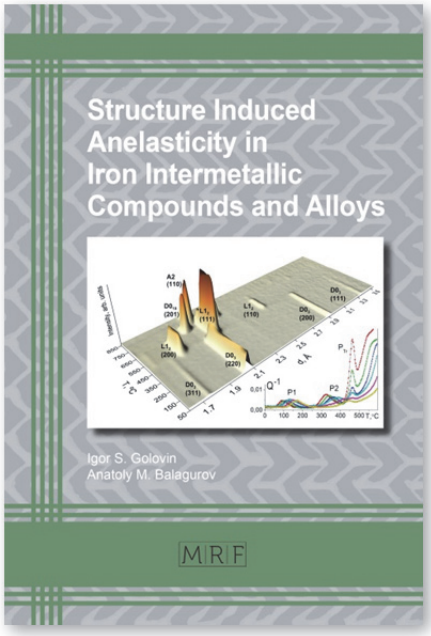
Materials Research
Solid State Physics and Engineering

Structure Induced Anelasticity in Iron Intermetallic Compounds and Alloys



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Different anelastic phenomena are discussed in this book with respect to iron-based binary and ternary alloys and intermetallic compounds of Fe_3Me type, where Me are α-stabilizing elements Al, Ga, or Ge. An introduction into anelastic behavior of metallic materials is given, and methods of mechanical spectroscopy and neutron diffraction are introduced for the better understanding of structure-related relaxation and hysteretic phenomena.

Keyword: Anelasticity, Damping Capacity, Magnetostricition, Structure Transitions, Phase Transitions, Fe-Based Alloys, Intermetallic Compounds, Mechanical Spectroscopy, In Situ Neutron Diffraction

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To characterize structure and phase transitions - both of the first and second order - in the studied alloys XRD, TEM, SEM, MFM, VSM, PAS, DSC techniques were used. Considerable emphasis is placed on *in situ* neutron diffraction tests that were performed with the same heating and cooling rates as the internal friction measurements. Different types of mechanical spectroscopy techniques were used to study mainly, but not exclusively, Fe-Al, Fe-Ga and Fe-Ge based alloys: from subresonance "low" frequency forced bending and torsion vibrations (0.00001 to 200 Hz) to "high" frequency resonance (above ~200 Hz) free decay bending vibrations.

We discuss (i) thermally activated effects like Snoek-type relaxation, caused by interstitial atom jumps in alloyed ferrite, (ii) Zener relaxation, caused by reorientation of pairs of substitute atoms in iron, (iii) different transient effects due to phase transitions of the first and second order, and (iv) amplitude dependent magneto-mechanical damping; especially with respect to structure, ordering of substitutional solid solution and phase transitions. Special attention is paid to magnetostriction of the alloys - the result of magneto-mechanical elastic coupling.

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