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► **To cite this version:**

L. Bresson, Mireille L. Harmelin-Vivien. Effect of structural relaxation on the plasticity of the Fe₇₈b₁₃ Si₉ amorphous alloy. *Revue de Physique Appliquée*, 1988, 23 (4), pp.717-717. 10.1051/rphysap:01988002304071700 . jpa-00245872

HAL Id: jpa-00245872

<https://hal.science/jpa-00245872>

Submitted on 4 Feb 2008

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EFFECT OF STRUCTURAL RELAXATION ON THE PLASTICITY OF THE Fe₇₈B₁₃Si₉ AMORPHOUS ALLOY

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Mechanical properties of metallic amorphous alloys are very sensitive to the metastable structural state. Whereas plastic instabilities associated with shear bands do not allow the study of plastic behaviour by means of uniaxial tensile tests, bending tests between parallel platens are a suitable way to investigate the plasticity of this kind of materials.

In order to regulate the strain rate of the ribbon surface at the apex, platen motion was step-motor driven and was monitored by a computer which controlled in real time the platen speed and position (Fig.1).

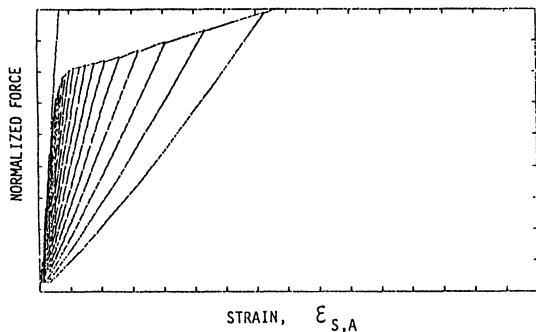


Fig.1- Renormalized bending test curve (with elastic unloadings).

The plasticity of the Fe₇₈B₁₃Si₉ amorphous alloy was analysed by means of cumulative strain increments solicitation mode associated with stress relaxation measurements at each strain increment.

The structural evolution induced by annealing was studied in comparison with the as-quenched state and was investigated by both bending tests and differential scanning calorimetry (DSC).

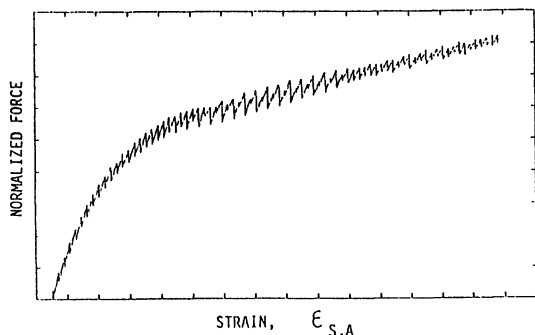


Fig.2- Incremental bending test curve associated with stress relaxation measurement.

The results obtained show that, whatever the metastable structural state, there exists a strong interaction between the plastic component of each strain step and the stress relaxation measured. This last point leads to a periodicity of the stress relaxation amplitude (Fig.2) of the previous step, the greater the elastic component - and thus the smaller the plastic component - of the next strain step.

Moreover (Fig.3), the stress relaxation amplitude decreases as the isothermal annealing time is increased. This is well correlated to structural evolution as detected by DSC (Fig.4).

This kind of test allows to study the amorphous state evolution toward further embrittlement appearance.

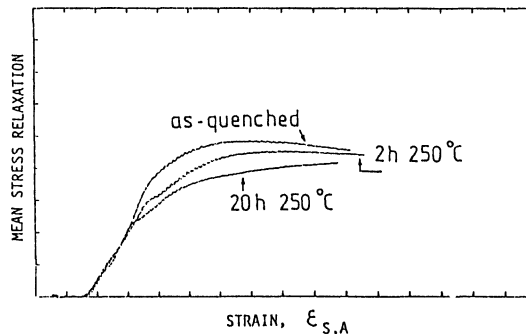


Fig.3- Stress relaxation evolution with structural relaxation.

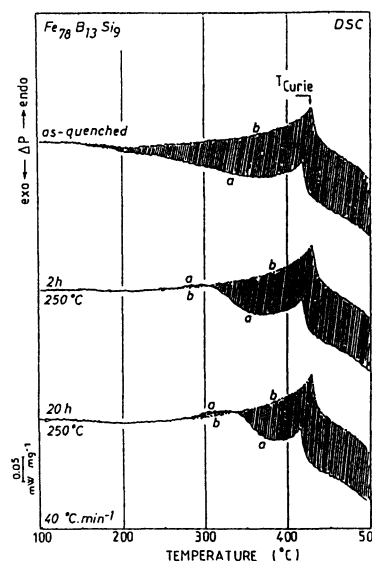


Fig.4- DSC evidence of the annealing induced structural relaxation.