EVALUATION OF FATIGUE DAMAGING BY CHANGES MODULUS DEFECT MEASURING

S. A. Golovin*, A. Puškár**

Effective elasticity characteristics of metallic materials at a number of loading cycles show corresponding structural changes due to the growth of dislocation density and their interaction. A brief description of amplitude, temperature and cycling influence on metals and steels modulus defect is given.

INTRODUCTION

Measurements of elasticity modulus E and G of annealed pure metals and carbon steels are done at reversion torsional pendulum (1 Hz) and at resonance system during cross-sectional (1 kHz) and longitudinal (23 kHz) oscilations of specimens.

Amplitude dependances of metal modulus defect are determined by certain laws (Fig. 1). Curves $\Delta E/E - \ln \varepsilon$ show two linear regions with different intensity of modulus defect. The second and more intensive section of the curve has taken place at $\varepsilon > \varepsilon_{cr}$. ε_{cr} corresponds to the accurance of microplastic hysteresis at strain cycling (1). Modulus defect has taken place at temperature higher than $T_{cr} = (0.35-0.4)T_{melt}$. With the growth of ε T_{cr} decreases and modulus defect increases.

Dislocation mechanism of microplasticity is developed at $T > T_{cr}$. Activation energies were calculated. From $\Delta E/E = (B \cdot \varepsilon^{1-n})^n$ parameters of fatigue were determined (1).

* Technical University, Tula, USSR
** University of Transport and Communications, CSSR

Table 1 - Comparison of Values of Material Constant B and Cycle work-hardening Coefficient n.

	Cu	Al	Fe	Mo	Nb	Ti	Steel (0.4 % C)
$\varepsilon_{cr} \times 10^4$	0,8	1	4	6	10	14	8
n	0,63	0,5	0,48	0,5	0,2	0,36	0,32
B	0,73	0,3	0,33	0,51	0,02	-	0,05

Fig. 2 shows ε influence on $\Delta E/E$ of iron under different loading conditions (I-III). Quick loading was tested for 3 min., slow 15-20 min. Other specimens were loaded at different amplitude of deformations $N = 2.10^6$ cycles (III). Commulative damage processes characterised by curves $\Delta E/E$ - lnN depend on the cycle amplitude deformation value.

REFERENCES

(1) Puškár A., Golovin S., Fatigue in Materials, Elsevier, 1985.

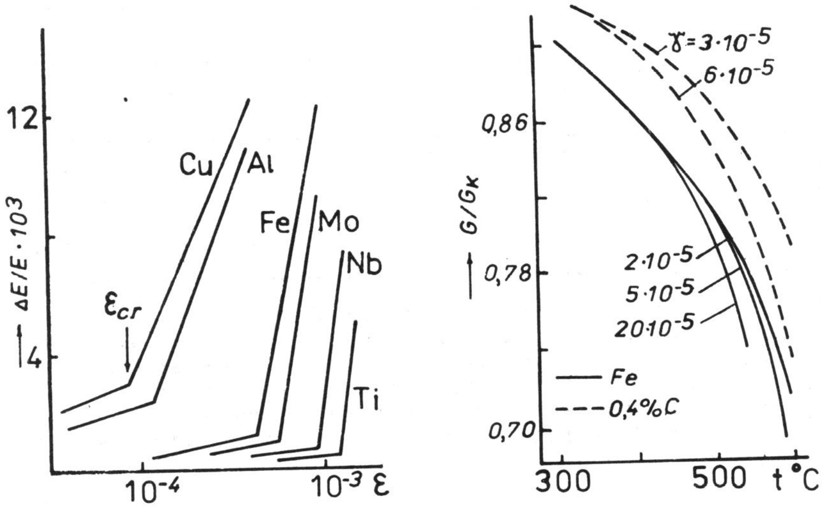

Figure 1 Amplitude and temperature influence

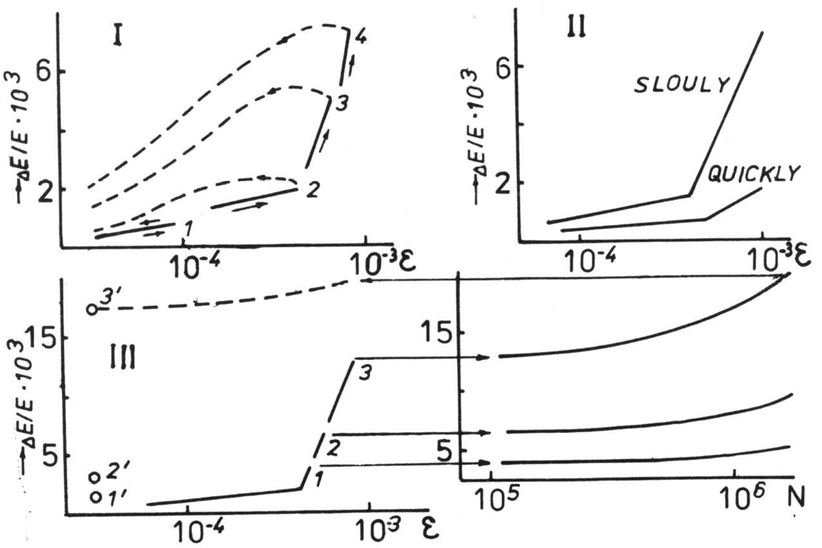

Figure 2 Strain cycling influence