6th International Conference
Fracture Mechanics of Materials and Structural Integrity
June 3–6, 2019, Lviv, Ukraine

INFLUENCE OF STRESS RATIO ON FUNCTIONAL FATIGUE OF PSUDOELASTIC NiTi ALLOY

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Keywords: pseudoelastic alloy; energy dissipation; residual stress; stress ratio.

The influence of stress ratio on functional was studied on pseudoelastic $Ni_{55.8}Ti_{44.2}$ alloy. Particularly, the changes of residual strain, strain ratio and dissipated energy on the stress ratio of shape memory alloy are studied.

Material have the following mechanical properties at 0°C, which is higher than the austenitic finish temperature ($A_f = -38.7$°C): yield strength, $\sigma_{0.2} = 447$ MPa, ultimate tensile strength, $\sigma_{UTS} = 869$ MPa [1, 2].

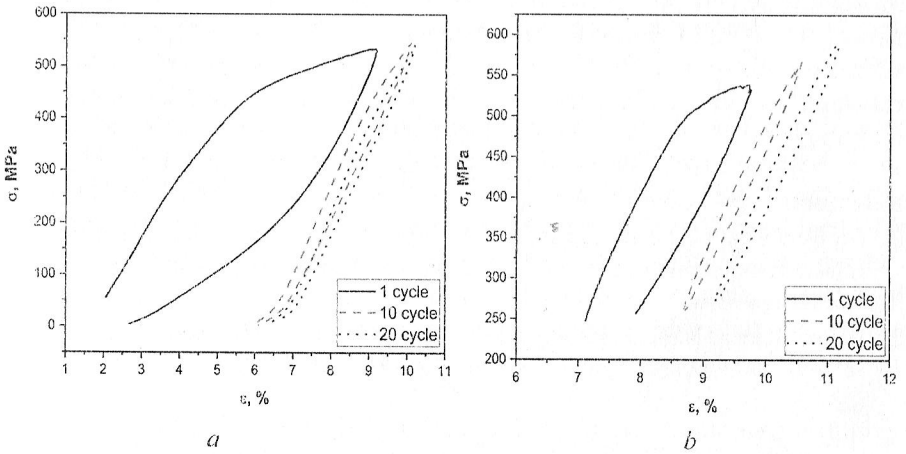

Fig. 1. Typical hysteresis loops for 1, 10 and 20 loading cycles, maximum stress $\sigma_{max} = 530$ MPa and stress ratio $R = 0$ (*a*), $\sigma_{max} = 596$ MPa and $R = 0.5$ (*b*).

Cylindrical specimens with the diameter of 4 mm and gage length of 12.5 mm were used for uniaxial cyclic tests under displacement controlled mode at temperature 0°C. Stress ratio was $r_s = S_{min} / S_{max} = 0$, where S_{min}, S_{max} are the minimum and maximum value of crosshead displacement, respectively. In this case, the maximum stress, except for the first twenty loading cycles, remains constant [1, 2]. Thus, it can be assumed that during testing the maximum and minimum stresses were controlled with the stress ratio $r_\sigma = \sigma_{min} / \sigma_{max}$ (σ_{min}, σ_{max} – minimum and maximum stress values).

Typical hysteresis loops obtained while testing under different stress ratio and stress range for 1, 10 and 20 loading cycles are shown in Fig. 1.

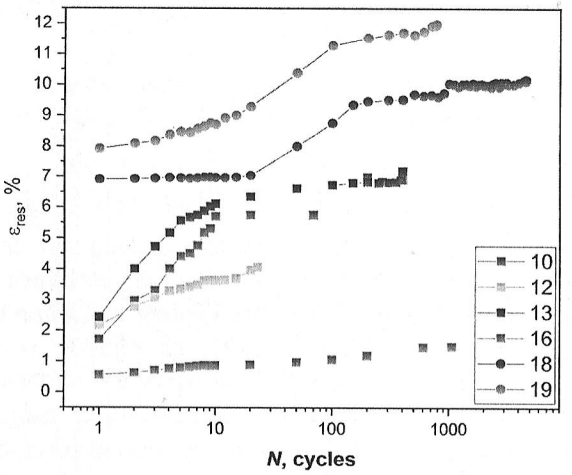

Fig. 2. Dependences of residual strain on the number of loading cycles under stress ratio $R = 0$ and $\sigma_{max} = 475$ MPa (16), 530 (13), 520 (10), 727 MPa (12); $R = 0.5$ and $\sigma_{max} = 596$ MPa (18) and 627 MPa (19).

Energy dissipation, and strain range at both values of the stress ratio are invariants to the loading cycles number at $N > 20$. When stress ratio increases from 0 to 0.5 at the equal maximal stress, the strain range and energy dissipation are decreasing. However, residual strain is increasing with R increase from 0 to 0.5 (Fig. 2).

References

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