

EXAMINATION OF ATHERMAL MARTENSITIC TRANSFORMATION RESULTING FROM CYCLIC DEFORMATION OF AUSTENITIC STEEL

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The paper presents results of kinetic of athermal martensitic transformation induced by strain in austenite. Examinations were performed for cylindrical specimens made up from unstable austenitic steel AISI 321. The sine cyclic load has been applied at frequency $f = 1$ Hz. The total strain amplitude was controlled $\varepsilon_a = \text{const}$. Registered quantities were: stress $\sigma(t)$, on line energy of plastic deformation $\Delta W(t)$ as well as its accumulation $\Sigma \Delta W(t)$. Increase of martensitic phase α' in austenite γ was detected with the help of NDT method making use of Villari effect (reverse magnetostriction) and original measurement devices. The shift of mean magnetic field intensity H_m constitutes a measure of the increase of ferromagnetic phase martensite α' .

Key words: athermal martensitic transformation, cyclic deformation, Villari effect, measurement

1. Introduction and aim of research

Athermal, i.e., strain induced martensitic transformation takes place as result of approaching (even at room temperature) certain critical value of plastic strain. Under cyclic loads it means the co-called the cyclic plastic strain limit of amplitude $\varepsilon_{pl} = \varepsilon_M$ [1–7]. Changes of mechanical properties precede this transformation what may entail catastrophic effects. In general, the transformation entails positive and negative features, thus examination of this process is important for fundamental research as well as from the point of view of applications.

Basic aims of this paper are listed below:

- kinetics of α' martensite increase in the bulk volume specimen (in the entire volume under measurement),
- application of Villari effect and suitable new measurement and diagnostic technique,
- usage of magnetic parameter as indicator of increase of α' martensite,
- determination of plastic strain energy $\Delta W(t)$ under cyclic loading,
- energetical criterion of initiation of transformation in bulk volume specimen.

2. Specimens and method of examination

Specimens were made up from austenitic steel AISI 321, with chemical composition presented in table 1. Heat treatment has been applied (1050 °C, 35 min, H₂O), to obtain uniform-material with single austenitic paramagnetic phase.

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