UNSTABLE PLASTIC DEFORMATION IN BIMETAL[1]

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Unstable plastic deformation of metals and alloys at the macroscopic level is manifested in the form of a sharp yield point, neck formation and discontinuous deformation [1]. The bands of macrolocalized deformation accompanying jumps of deformation and/or stresses impair the industrial products surface quality, cause their premature corrosion and increase the probability of sudden destruction. Studies of the nonuniformity of materials deformation had been previously made in detail on specimens of pure metals and alloys [2]. This paper considers the deformation behavior of a corrosion-resistant bimetal – carbon steel - stainless steel – which is used in chemical engineering for the manufacturing of reaction columns, autoclaves, reactors and heat exchangers [3].

Pre-prepared bimetallic samples in the form of a double dog bone with the dimensions of the working section 42×8×2 mm were extended at T = 300K at a rate of $6{,}67\times10^{-5}c^{-1}$ on LFM-125 test machine.

Visualization of the localized plastic deformation bands and registration of their proliferation kinetics was carried out at the working portion of the sample by the length of 42 mm by two non-contact methods: the method of digital image speckle correlation and the method of digital statistic speckle photography [4].

The research conducted allowed to identify the main patterns of proliferation of localized zones of plastic deformation in the bimetal. It is revealed that plastic deformation start from Lüders band (LB) formation in the main layer of the A 283 Grade C material.

The average propagation velocity of the bands in the main layer material (A 283 Grade C) is Vaw.= $0.8\bullet10^{-4}$ m/s and Vaw.= $2.4\bullet10^{-4}$ m/s in the upper cladding layer of the material A 283 Grade C the Lüders bands front propagate with velocities Vaw = $2.4 \bullet 10^{-4}$ m / s, Vaw = $0.7 \bullet 10^{-4}$ m/s, Vaw = $2.3 \bullet 10^{-4}$ m/s.

To compare the data, note that when analyzing the patterns of localization of deformation of samples of 321 AISI low-carbon steel and A 283 Grade C steel under tension, the following was revealed.

The generation of localized fronts in 321 AISI steel corresponds to the total deformation of ε_{tot}= 0.6 %. As a result, one LB front propagates throughout the yield plateau with the velocity Vaw = 1.1 • 10-4 m/s.

The zones of localized plastic deformation are formed in A 283 Grade C steel when total deformation of ε_{tot}= 40 %. The sequences of the plastic deformation localization zones are found at the linear-hardening stage, their propagation velocities are Vaw.= $2.1\bullet10^{-4}$ m/s, Vaw.= $1.7\bullet10^{-4}$ m/s, Vaw.= $1.3\bullet10^{-4}$ m/s.

From the data of the experimental results, it can be concluded that in the process of deformation of the materials, bands of localized plastic deformation are observed in both single-layer materials and in multilayered metallic materials. The main difference between them lies in the nature of the propagation and the place where this fronts arisen.

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