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INFLUENCE OF IRRADIATION BY AN INTENSE PULSE ELECTRON BEAM ON THE MECHANICAL PROPERTIES OF THE COMPOSITE MATERIAL "FILM (Ti)/(SILUMIN AK5M2) SUBSTRATE"

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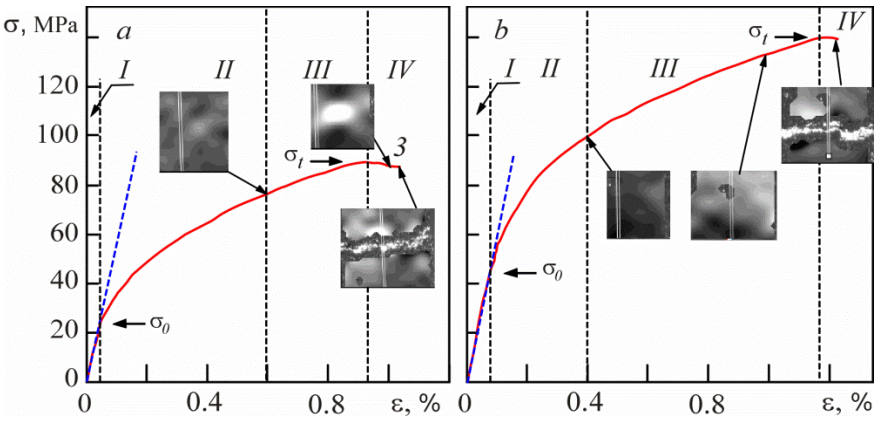
Alloys based on Al-Si (silumins) are widely used in Russian and foreign industries. A significant disadvantage of silumins is increased fragility. One of the methods for improving the mechanical properties is the modification of the alloy surface by concentrated energy flows. This paper presents the results of studies of the mechanical properties of AK5M2 silumin samples, the surface layer of which is modified by irradiating the “film (Ti)/(AK5M2) substrate” system with a pulsed electron beam.

Under conditions of uniaxial tension of flat proportional samples in the initial state and samples with a modified surface, deformation curves were obtained in the stress-strain coordinates (Fig. 1). The deformation was carried out on an INSTRON 3386 testing machine. The evolution of deformation fields during testing was recorded using a VIC-3D optical measuring system. The deposition of a Ti film 0.7 μm thick on silumin samples was carried out on a KVINTA setup. The samples were irradiated with a pulsed electron beam using a SOLO setup (30 J/cm2, 200 μs, 3 pulses).



Rice. Fig. 1. Diagrams of deformation of samples of AK5M2 silumin under uniaxial tension: a - initial state; b - composite material "film (Ti)/(silumin AK5M2) substrate", irradiated with a pulsed electron beam. The insets show fragments of the distributions of deformation fields on the surface of the samples.

On the deformation curves, four stages of deformation can be distinguished: I - the stage of elastic deformation; II and III - hardening stages with a parabolic functional dependence of the form with different values of the coefficients θ and n:

$$\sigma = \sigma_0 + \theta\varepsilon^n \quad (1)$$

where σ_0 – yield point; $\theta(\varepsilon)=d\sigma/d\varepsilon$–strain hardening factor; $n<1$ – strain hardening index. Stage IV - the stage of sample pre-fracture. The numerical values of the parameters from equation (1) for the original and modified samples are given in the table. From the given data it can be seen that the modification of the surface layer of samples of silumin brand AK5M2 led to an increase in the strength and plastic properties of the material

Table. Parameters characterizing the strength properties of AK5M2 silumin

Sample	σ_0, MPa	σ_t, MPa	n_{II} на стадии II	n_{III} на стадии III
Initial	24±3	90±15	0.49±0.02	0.31±0.02
Modified	45±3	140±15	0.49±0.02	0.31±0.02

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