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DIFFUSION WELDING OF METALS WITH PRELOMINARY LASER TREATMENT OF WELDED SURFACES

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When implementing the technology of diffusion welding, there are applied various methods to intensify the process of formation of one-piece joints [1,2]. It is done in order to decrease a thermal deformation impact onto welded materials, to shorten the welding technology process cycle and to extend the nomenclature of welded materials.

The following items are used as the main methods [1,2]:

- interfacial layers made of metallic foils, sputtered and galvanic films, superdispersed metallic powders;
- cyclic changes of the process temperature and/or the welding pressure;
- directing some ultrasonic oscillations into the contact zone;
- placing the welded parts into an electrostatic field;
- preliminary impact of ionizing emission, neutron, α-particle, γ-ray and electron irradiation onto the welded surfaces.

In the recent years, the simplest in its performance technology and relevant with achieved results method has been the method of activation of the welded surfaces by the laser emission [3,5], especially when taking into account a relative cheapness of used equipment and technology processes applied to prepare and treat the surfaces.

There was explored a possibility to lower the diffusion welding process temperature T (at the same welding pressure P and delay time t) of welded specimens of stainless steel 12Kh18N10T (2X18H10T), the surfaces of which had preliminarily been under the laser treatment. When the laser treating, only the emission density E was changed in different modes (2.1 J/sm^2, 3.2 J/sm^2 and 4.3 J/sm^2, 220 μm spot diameter), and also the beam was scanned both in the same direction and in mutually perpendicular directions. The end faces of stainless steel specimens (30 mm height, 16 mm diameter) after a turning machining had Rz=1.2 μm. On completing the laser treatment, the Rz size of each specimen was measured by the "Profilograph – profilometer 252" instrument. The results demonstrated that as the E value increases, the height and form of microroughnesses change from 13.6 μm to 45.5 μm.

The carried out researches showed that the maximum strength of welded joints ($\sigma_в$ = 10.8 kgf/mm^2) belonged to the specimens having R_z = 45.5 μm with a conical form of microroughnesses with minimum angles of their apexes. The uniform strength of welded joints of steel 12Kh18N10T (12X18H10T) with the preliminary laser treatment of welded surfaces with the emission density of 4.3 J/sm^2 can be obtained at T= 950°C.

REFERENCES

[1] N.F. Kazakov. Diffusion weldung of materials. M.: Mashinostroyenie, 1976, 312 pages

[2] A.V. Liushinskii. Special methods of welding. M.: KNORUS, 2020, 208 pages

[3] V.N. Yelkin, T.V. Malinskiy, S.I. Mikolutskiy, R.R. Khasaya, Y,V. Khomich, V.A. Yamshchikov. Influence of the nanosecond laser pulse emission on the structure of surface of metallic alloys. "Физика и химия обработки материалов" ("Physics and chemistry of treatment of metals"), 2016, No.6, pp. 5-12.

[4] A.V. Liushinskii, V.N. Yelkin, V.N. Petrovskiy and others. Diffusion welding of metallic surfaces undergone a preliminary laser treatment. "Физика и химия обработки металлов" ("Physics and chemistry of treatment of metals"), 2021, №5, pp.22-29.

[5] A.V. Liushinskii. Influence of the laser treatment of welded surfaces on the properties of diffision welded joints. Сварочное производство (Welding production), 2022, No.4, pp.37-42.