

Nanostructured surfaces

Nanostructured surface layer produced by ultrasonic impact treatment and electric spark alloying for enhanced fatigue durability and corrosion resistance of low carbon cast steel

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Ultrafine-grained (UFG) surface layers were produced in 20GL low carbon cast steel by combined ultrasonic impact treatment (UIT) [1] and electric spark alloying (ESA) [2]. Stress-controlled fatigue response of the specimens is studied and compared with those for the annealed and UIP-treated specimens [3]. XRD, TEM and SEM analyses are used to characterize formed surface layers and fatigue fracture surfaces. The surface layer alloyed with chromium after the UIT process contained UFG microstructure and squeezed by high compressive residual stresses. It demonstrates almost triple increase in microhardness and enhanced corrosion resistance in saline solution comparing to that for the annealed specimen.

Superior fatigue endurance in low and high cycle regimes for 20GL cast steel after the UIT+ESA-induced formation of the UFG alloyed layer is explained by (i) sufficiently high ductility and resistance to fatigue damage and crack growth in the core parent material, (ii) superior fatigue strength supported by high microhardness and tight bonding of the alloyed layer to the core material and (iii) sub-surface fatigue cracks' initiation promoted with high compressive residual stresses.

1. *Mordyuk B., Prokopenko G., Fatigue life improvement of α -titanium by novel ultrasonically assisted technique // Mater.Sci.Eng. A, 2006.- 437, P. 396-405.*

2. *Prokopenko G., Mazanko V., Mordyuk B., Karasevskaya O., Popova T. The physical and mechanical characteristics of 20GL cast steel after electric spark alloying and ultrasonic impact treatment // Visnyk Ternopil Nath.Tech.Univ.-2013.- N3. P.170-181.*

3. *Byalanovich A.V., Matokhnyuk L.E. Investigation of fatigue damage accumulation in steels using the Fourier transform of the structure image // Strength Mater.- 2011.- 43, N6; P. 687-693.*