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Surface microstructure and property modifications in a duplex stainless steel induced by high current pulsed electron beam treatments

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Abstract: In the present work, a 2205 duplex stainless steel was treated by high current pulsed electron beam (HCPEB) with the aim of improving its surface properties. The microstructure, phase components and properties in the surface layer before and after HCPEB treatments under different number of pulses were characterized. The HCPEB treatments induced the formation of craters on the surface with cracks in the center after 5 puleses due to the tensile stress during cooling, while cracks disppeared after 15 pulses of repeated meting. X-ray diffraction and electron backscattered diffraction (EBSD) measurements showed that the content of α-Fe phase increases in the treated surface layer after the HCPEB treatment, which can be mainly attributed to the homogenization of chemistry induced by the treatment. The microhardness increased to about 380 HV in the surface layer of 15 pulses treated sample. The depth of hardened layer increased with increasing the number of pulses, reaching about 400 μm for the 15 pulsed sample, far beyond the heat affected zone. Corrosion tests in the 3.5wt% NaCl water solution showed that the corrosion potential increased from -0.99 mV for the untreated sample to -0.28 mV for the 15 pulses treated sample. While the corrosion current density also increased from 1.44×10^{-5} A/cm^2 for the untreated sample to 6.42×10^{-5} A/cm^2 for the 15 pulses treated sample.

Keywords: high current pulsed electron beam (HCPEB); surface modification; duplex stainless steel; hardness; corrosion

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