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The Influence of Heat Treatment and Process Parameters Optimization on Hardness and Corrosion Properties of Laser Alloyed X12CrNiMo Steel

A. P. I. Popoola[1] · O. S. Fatoba[1] · O. M. Popoola[2] · S. L. Pityana[3]

Abstract

Martensitic stainless steels are used in the production of steam turbine blades but their application is limited due to low hardness and poor corrosion resistance. Laser surface alloying and heat treatment of X12CrNiMo Martensitic stainless steel was conducted with the aim of enhancing hardness and corrosion properties. A Rofin Sinar Continuous Wave Nd: YAG solid-state laser was used to alloy the specimens. The electrochemical and hardness properties were studied using potentiodynamic polarization technique and Vickers micro hardness tester. The microstructures of the as-received, post-heated and pre-heated specimens were investigated by a Scanning Electron Microscope (SEM) and Optical Micrograph (OM) respectively. From the experimental results, the post-heated specimens exhibited the highest hardness property as compared to all other specimens. There was also significant improvement in the corrosion resistance of the post heated specimen compared to all other specimens and the substrate as evidenced by higher polarization resistance and lower corrosion rates. From the analysis of grey relational grade model, the significant laser processing parameters were identified. The results showed the influence of laser power and scanning speed on the corrosion rate, hardness and alloyed depth. The predicted results were found to be in good agreement with the experimental results.