International Journal of Nanoelectronics and Materials
IJNeaM
ISSN 198-5761 | E-ISSN 2232-1535

Effect of TiC Nanoparticles Deposition on UNS S31803 Surface using Tungsten Arc Melting Method

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Received XXX 2023, Revised XXX 2023, Accepted XXX 2023

ABSTRACT

This study focused on the application of nanoceramic particles to enhance the surface properties of UNS S31803 steel through the deposition of titanium carbide (TiC) nanoparticles, sized 5 nm and 10 nm, using the tungsten arc melting technique. Despite its advantages, UNS S31803's soft material and low wear resistance are significant challenges for engineering applications, requiring innovative durability solutions. The primary objective is to investigate the impact of varying melting processes on the composite coating layer, with an emphasis on improving hardness and wear resistance. The methodology involved precise control of tungsten arc melting parameters, including a constant arcing current of 140 A and varying pulse rates of 15, 20, and 25 Hz, to ensure optimal particle bonding and uniform distribution of TiC nanoparticles. Microstructural analysis, hardness testing, and wear performance were assessed using Field Emission Scanning Electron Microscopy (FE-SEM), Energy Dispersive X-Ray Spectroscopy (EDX) analyzer, Vickers microhardness testing, and reciprocating wear tests. Results indicate that the 5 nm TiC nanoparticles, processed at 140 A with 25 Hz, achieved the best outcomes, with a high element composition of TiC with 91.6%, a maximum microhardness of 415.96 Hv, and the lowest wear rate of 1.01 x 10^{-5} mm^3/Nm, with shallow surface grooves. This study provides valuable insights for industries seeking to improve the durability of wear resistant components, contributing to advancements in surface engineering and sustainability.

Keywords: *nanomaterials, titanium carbide, nanocomposite coating, surface modification, tungsten arc melting*