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# Microstructure and dry-sliding wear properties of TiC/$CaF_2$/γ-Ni self-lubricating wear-resistant composite coating produced by co-axial powder feeding plasma transferred arc (PTA) cladding process

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## Abstract

For improving the surface tribological properties of AISI 304, co-axial powder feeding PTA cladding process was adopted to produce the TiC/$CaF_2$/γ-Ni self-lubricating wear-resistant composite coating on AISI 304 substrate using powders blend of Ni, Ti, Ni-P encapsulated $CaF_2$ and Ni-P encapsulated graphite as raw material. The TiC/γ-Ni wear-resistant composite coating as reference was also fabricated on AISI 304 substrate by co-axial powder feeding PTA cladding process using powders blend of Ni, Ti and Ni-P encapsulated graphite as raw material. OM, SEM, XRD and EDS were employed to analyze the microstructure of the PTA cladding coatings. Microhardness distribution along the depth direction of the PTA cladding coatings was measured. Dry-sliding wear resistance of the PTA cladding coatings were evaluated. Test results show that the PTA clad TiC/$CaF_2$/γ-Ni composite coating with an average thickness of 3.2 mm as well as fine and dense microstructure was successfully produced by co-axial powder feeding PTA cladding process. The PTA clad TiC/$CaF_2$/γ-Ni composite coating exhibits high hardness and excellent self-lubricating wear-resistant properties compared with AISI 304 reference specimen. Benefiting from the formation of low shear strength transferred layers which mainly consists of $CaF_2$ solid-lubricating phase, the PTA clad TiC/$CaF_2$/γ-Ni coating presents higher wear resistance and lower friction coefficient compared with the PTA clad TiC /γ-Ni coating, although its hardness is lower than that of the PTA clad TiC /γ-Ni coating.

***Keyword:*** *Co-axial powder feeding PTA cladding; Composite coating; Microstructure; Wear, Self-lubricating.*

## 1. Introduction

AISI 304 as a typical low carbon austenitic stainless steel is widely used in chemical, petrochemical, nuclear reactor and other corrosive conditions owing to its good intergranular corrosion resistance, excellent ductility and moderate strength [1]. Suffering from inherent low hardness and austenitic

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