ADVANCES IN MATERIALS ENGINEERING

Volume 1

Edited By:
Zahurin Halim
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Chapter 017

Wear of Nitride Coating Produced by Ti-Al Melt Synthesis in Nitrogen Environment

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Keywords: TiG surface melting, Steel, Melt pool, Dendrites of nitride and aluminide, Hardness. Wear

Abstract. Surface modification with harder components is generally required to protect material surfaces from wear and other environmental effects. In this work, a synthesized hard layer was created on steel surfaces by melting of preplaced titanium and aluminum powder under a Tungsten Inert Gas (TIG) torch in a pure nitrogen environment. The energy input of the TIG torch for melting the preplaced powder layer was varied by controlling the current and scanning speed of the beam. The resolidified layers produced with different energy inputs and powder contents revealed dendritic microstructures with dispersed nitride and intermetallic phases in ferrite matrix. The dendrite population varied with processing conditions, especially the energy input of the TIG torch. The dendrite concentration is highest near the surface and the concentration slowly decreased away from the surface towards the deeper melt depth. The maximum hardness of the modified surface layer was found to be 900 Hv compared to180 Hv for the mild steel substrate. The wear property of the resolidified melt track, investigated using pin-on-disk method in dry sliding condition at room temperature and characterized using optical profilometer and SEM, produced low coefficient of friction with wear resistance10 times higher compared to the base metal.

Introduction

The reason behind surface modification or forming a cladding layer on surface is to obtain a superior wear and corrosion resistance properties in engineering components. For dynamic applications particularly in automotive industries, components are required to possess ductile property at the core for impact loading while the surface requires high hardness to increase load bearing capacity and wear resistance. Similarly for applications in aggressive atmospheres such as high temperature and corrosive environments the components are required to be protected by coatings with materials of better resistance to the aggressive conditions. Surface engineering is employed to make the component competitive and better suited in terms of price and service applications. The required surface properties can be achieved by adding ceramic particles, depositing hard materials, forming intermetallic or changing the surface microstructure and compositions. The use of surface coatings opens up the possibility where a cheaper and low strength substrate material can be designed in order to get higher strength and toughness, and the coating is responsible for the resistance to wear, thermal loads and corrosion [1].

Plain carbon steels possess a combination of superior mechanical properties and toughness and so widely used as structural materials and machine parts [2]. These steels are used in many mechanisms like automobile parts, chemical industry where corrosion and wear resistance are crucial. Oxidation, wear and corrosion accelerate at high temperature environments. At this environment, this material is very prone to survive. So, a protective coating or modification of the surface structure is necessary to apply on component surfaces. Surface nitriding to form a hard