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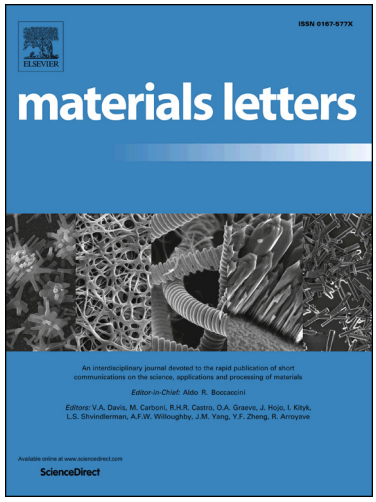

A novel Ti-Fe composite coating deposited using laser cladding of low cost recycle d nano-crystalline titanium powder

Keivan.A. Nazari, R.A. Rahman Rashid, S. Palanisamy, K. Xia, M.S. Dargusch

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A novel Ti-Fe composite coating deposited using laser cladding of low cost recycled nano-crystalline titanium powder

Keivan. A. Nazari[a,d]*, R.A. Rahman Rashid[a,d], S. Palanisamy[a,d], K. Xia[b,d], M.S. Dargusch[c,d]

[a] School of Engineering, Faculty of Science, Engineering and Technology, Swinburne University of Technology, VIC 3122, Australia

[b] Department of Mechanical Engineering, University of Melbourne, Victoria 3010, Australia

[c] Queensland Centre for Advanced Materials Processing and Manufacturing (AMPAM), School of Mechanical and Mining Engineering, The University of Queensland, QLD 4072, Australia

[d] Defence Materials Technology Centre, VIC 3122, Australia

* Corresponding author: knazari@swin.edu.au; keivan.nazari@gmail.com

Abstract

In this study, for the first time, titanium powder recycled from machining swarf was used for cladding a novel Ti-Fe coating on a titanium substrate. Post deposition microstructures revealed a dendritic structure throughout the composite coating followed by a fine martensitic α′-Ti phase in the heat affected zone. Additionally, iron in the form of Fe_2O_3 and Fe_2C along with TiC and TiO_2 phases were also found which significantly contributed to the very high hardness (620-815 HV) of the coating. This hard composite coating can effectively improve the wear resistance of the titanium alloy, thereby finding applications in the aerospace and defence industries.

Keywords: Ti-Fe composite coating, Titanium, Recycled powder, Laser processing, Ball milling, Microstructure

1. Introduction

Titanium alloys are increasingly used in aerospace, automotive, and medical industries owing to their high strength/weight ratio, excellent corrosion resistance, and a wide range of mechanical properties. Nevertheless, they have poor tribological properties for which their application to components experiencing severe wear/erosion environments is very limited [1]. Various composite coatings including Ti-based [2, 3], Ni-based [4], Co-based [5], and Fe-based [6] materials deposited onto titanium alloys using laser cladding process has been reported to be effective in improving the surface and tribological properties of the underlying substrate. Although, several researchers have reported good cracking resistance and improved wear performance of Ti-Fe coatings on steel substrates [7, 8], the cladding of Ti-Fe-based coating on a titanium substrate has not been investigated.

On the other hand, when cladding composite coatings such as Ti-TiCN [9] and Al-TiC [10], two or more metal/alloy powders are used. It is well known that the cost of most of the metal/alloy powders is significantly high due to the use of conventional high energy powder