Titanium-based PVD Coatings for Improved Electrochemical and Tribomechanical Durability in Demanding Environments

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Through plasma-assisted PVD, multi-layered metallic/ceramic coatings of TiAlB/TiAlBN were deposited onto AISI 304 stainless steel substrates for tribological tests. The composition and structure of the monolayers TiAlB and TiAlBN, as well as the multilayered system, have been characterised. The hardness and elastic modulus were determined by nanoindentation. The tribological studies were conducted with a reciprocating sliding test machine from room temperature to demanding operational conditions of high temperature, to observe how the environmental surroundings influenced the performance of the coatings.

Keywords: tribology, titanium-based coatings, wear, PVD

1. Introduction

It is well known that TiAlB coatings have a strong tendency for grain refinement or amorphisation [1], while TiAlBN can develop BN phases that are able to form superhard nanocrystalline ceramic composites[2]. It has also been observed that both types of coating possess excellent temperature resistant properties [1, 2].

By creating a multilayered system, we expect to develop coatings that combine the best galvanic/tribological characteristics of each metallic/ceramic layer, resulting in combined high resistance to both corrosion and wear.

2. Methods

In order to obtain the coatings, a plasma-assisted PVD equipment was used. To study the tribological behaviour of the coatings, a reciprocating sliding test machine, from room to demanding conditions was employed.

2.1 Coatings deposition
To synthesise the coatings, a Hauzer Flexicoat 850 PVD system was used. A three-piece segmented target configuration was employed, with two compositional layouts: a) TiB_2/Ti/Al and b) TiB_2/TiAl/Al. For the TiAlBN coatings, N_2 was introduced as a reactive gas.

2.2 Coatings characterisation
GDOES, XRD and SEM were used to evaluate coating composition and structure. For roughness and thickness, a DEKTAK mechanical profilometer was used. Hardness and elastic modulus were determined by nano-indentation.

2.3 Tribological studies
A Bruker UMT TriboLab instrument was used with an alumina counter-body, to evaluate wear, friction and tribocorrosion behaviour in different environments. To assess the tribosystem, an optical profilometer and other techniques for compositional evaluation were employed.

3. Discussion

Characterisation of the TiAlB and TiAlBN monolayers provided the necessary data to select the best layers to study the multilayered system TiAlB/TiAlBN. Not only the composition and structure were considered, but the H/E ratio was also taken into account.

In such a manner, we could determine the deposition parameters required to synthesise the desired multilayer coating architectures. These coatings are expected to help broaden understanding of the tribological performance of titanium-based PVD coatings in demanding environments.

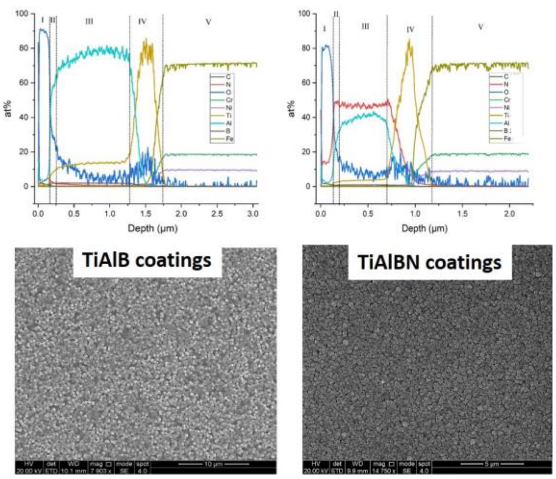

Figure 1: GDOES depth profile and SEM images of the surface of selected TiAlB and TiAlBN coatings.

4. Acknowledgements

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5. References

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