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Upgraded Interface Bond by *In situ* Oxidation inside Metal Clay Coatings

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Abstract

Metal-ceramic coatings are widely used in a range of industrial applications due to their ability to provide excellent wear resistance, corrosion protection, and thermal insulation. One of the key factors that affects the performance of metal-ceramic coatings is oxidation. Oxidation can occur within the coating, leading to changes in its microstructure and properties. In this article, we will discuss the mechanisms of oxidation within metal-ceramic coatings and its effects on the coating properties. Oxidation is a chemical reaction that occurs between a metal and oxygen in the presence of heat or a catalyst. In metal-ceramic coatings, the oxidation of the metal component can occur within the coating due to exposure to high temperatures or oxidizing environments. The metal component of the coating typically consists of metals such as chromium, aluminum, or titanium, which have a high affinity for oxygen.

Keywords: Industrial applications • Metal-ceramic coatings • Oxidizing environments

Introduction

The oxidation process within metal-ceramic coatings can occur via several mechanisms, including diffusion-controlled oxidation, scale growth, and internal oxidation. In diffusion-controlled oxidation, oxygen diffuses into the coating and reacts with the metal to form an oxide layer. The thickness of the oxide layer depends on the diffusion rate of oxygen and the reaction rate between oxygen and the metal. Scale growth involves the growth of an oxide layer on the surface of the coating, which can be either continuous or discontinuous. In internal oxidation, oxygen diffuses into the coating and reacts with a specific alloying element, resulting in the formation of an oxide phase within the coating. The oxidation of the metal component within the coating can have a significant impact on the properties of the coating. One of the main effects of oxidation is the formation of an oxide layer, which can act as a barrier to further oxidation and provide corrosion protection. However, the oxide layer can also affect the adhesion of the coating to the substrate, as well as its wear resistance and thermal insulation properties.

Literature Review

The formation of an oxide layer within the coating can affect the adhesion of the coating to the substrate by reducing the strength of the bond between the coating and substrate. The oxide layer can also increase the coefficient of friction between the coating and the substrate, leading to increased wear and reduced performance. The formation of an oxide layer can also affect the wear resistance properties of the coating. The oxide layer can act as a protective barrier against wear, but if the oxide layer is not continuous, it can result in increased wear due to the exposure of the underlying metal to the environment. The thermal insulation properties of the coating can also be affected by oxidation. The formation of an oxide layer can increase the thermal conductivity of the coating, reducing its ability to insulate against heat. However, if the oxide layer is continuous, it can act as a barrier to heat transfer, improving the thermal insulation properties of the coating [1,2].

Discussion

To prevent or mitigate the effects of oxidation within metal-ceramic coatings, several techniques can be used. One approach is to use oxidation-resistant metals, such as chromium or titanium, as the metal component of the coating. Another approach is to modify the microstructure of the coating to promote the formation of a continuous oxide layer. This can be achieved through the addition of specific alloying elements or by controlling the processing conditions during the fabrication of the coating. In summary, oxidation within metal-ceramic coatings can have a significant impact on the properties of the coating, including its adhesion, wear resistance, and thermal insulation properties Depositing continuous gradient transition bond coats on the metal/ceramic substrate interface reduces the stress gradient between the substrate and top coats, and nanoscale coatings enhance the interface's fracture toughness and anti-crack growth capability. This is the most efficient method for increasing the durability of the metal/ceramic interface. Additionally, the lattice mismatch between the metal and the ceramic is lessened when interface nailing ceramic sheets are deposited through in-situ oxidation. However, the performance of the mechanical properties of the metal/ceramic coating systems is partially responsible for the durability of the interface [3-5].

Conclusion

The mechanisms of oxidation within metal-ceramic coatings can vary depending on the composition and processing conditions of the coating. To mitigate the effects of oxidation, a range of techniques can be used, including the use of oxidation-resistant metals and the modification of the microstructure of the coating.

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Conflict of Interest

None.

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