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Investigation of the performance of Hf-doped aluminum coatings on the oxidation resistance of TNM-B1 alloy

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Introduction

The TNM-B1 (γ-TiAl) alloy exhibits significant potential for aerospace applications owing to its high specific strength. However, its limited oxidation and corrosion resistance under thermal cycling conditions hinders its widespread application [1-2]. Aluminum-rich coatings have been investigated to improve oxidation resistance through the formation of protective $TiAl_3$ and $TiAl_2$ phases; nevertheless, these intermetallic phases may exhibit mechanical brittleness under cyclic loading and thermomechanical stresses [2-3]. In this context, the addition of hafnium (Hf) has emerged as a promising strategy to enhance the adhesion, structural integrity, and thermodynamic stability of protective oxide layers.

Objective

To investigate the influence of Hf addition on aluminum-rich coatings for TNM-B1 (γ-TiAl) alloy, focusing on improving the stability and oxidation resistance of protective layers.

Methodology

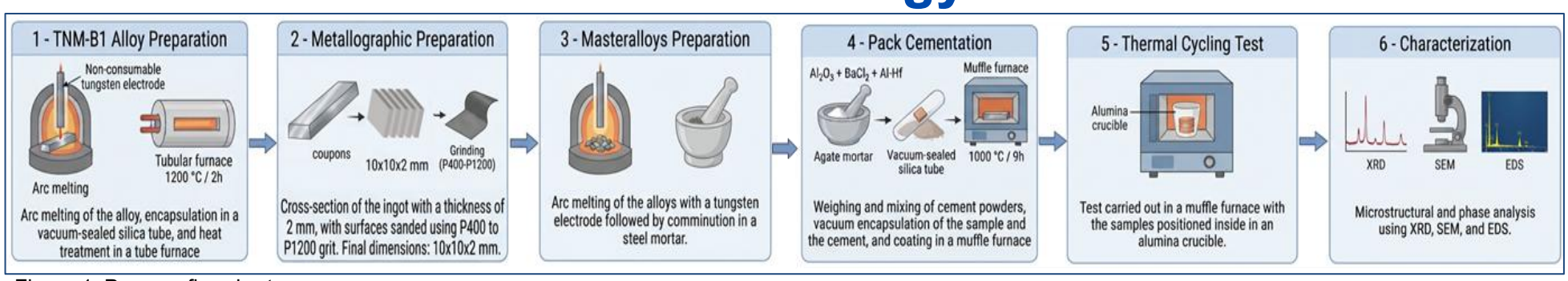
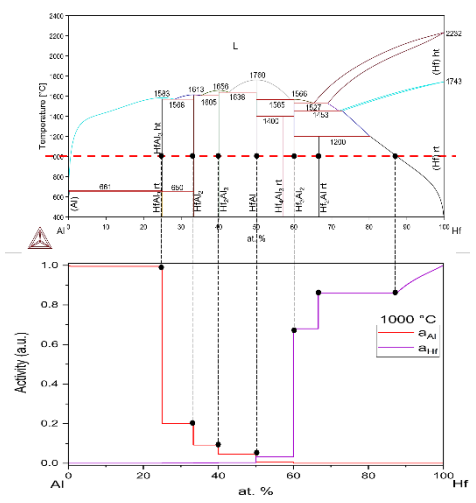
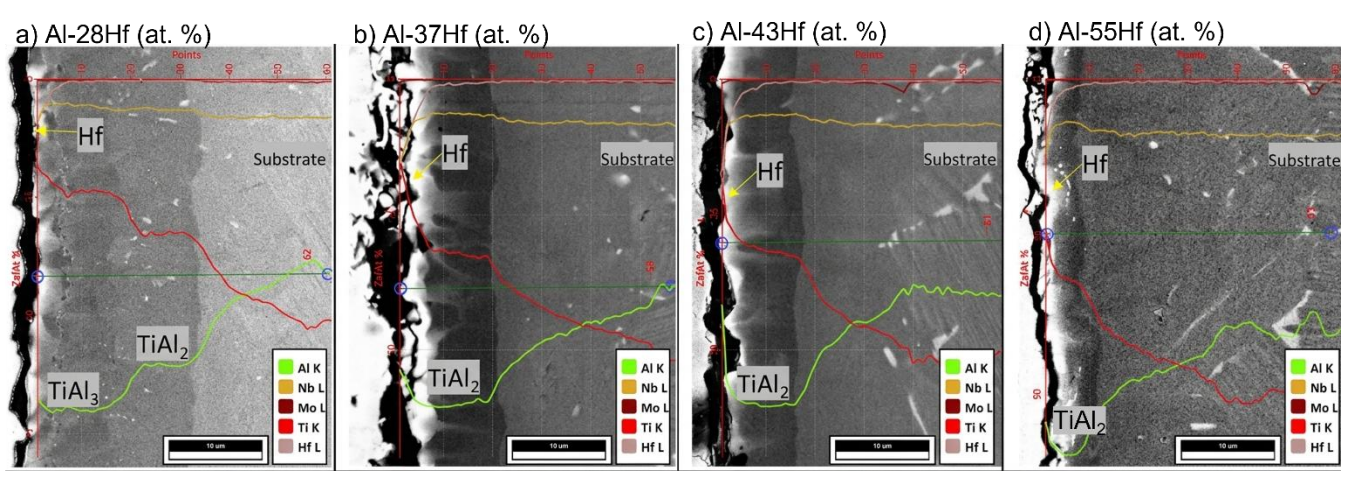
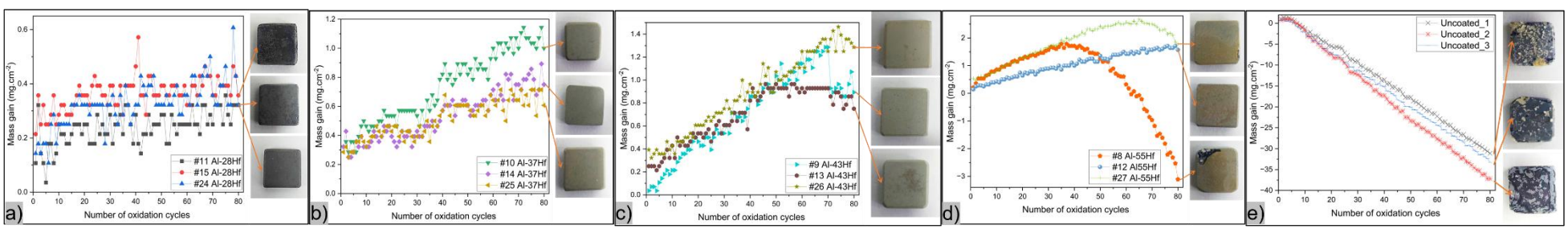


Figure 1. Process flowchart
Fonte: Image generated by Gemini, 2026.

Results and discussion







Conclusions

Preliminary results indicate the formation of aluminum-rich phases ($TiAl_3$ and $TiAl_2$), with Hf distributed along the coating surface. Metallographic characterization showed coatings with good adhesion, uniformity, absence of cracks and pores, and full substrate coverage. Oxidation tests presented a quasi-parabolic behavior, typical of solid-state diffusion-controlled processes, with some deviations possibly associated with the complexity of oxide phases and the interaction of reactive elements.

References

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