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Corrosion behaviors of TiNi/Ti₂Ni matrix coatings in the environment rich in Cl ions

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Abstract

The TiNi/Ti₂Ni matrix coatings were fabricated on Ti6Al4V by laser cladding. The effects of TaC on corrosion behavior of the coatings in 0.1 mol/L HCl were investigated. The coatings mainly consisted of TiNi/Ti₂Ni (the matrix) and TiB/TiB₂/TiC (the ceramic reinforcement). Corrosion resistance of the coatings was significantly increased when compared with that of the substrate. The average values of corrosion potential (E_{corr}) and reaction resistance (R_{ct}) were increased to -0.25 V and $3.79\text{E}6\ \Omega\cdot\text{cm}^2$ (-0.42 V and $1.26\text{E}4\ \Omega\cdot\text{cm}^2$ for the substrate), and the average passive current density (I_{p}) was reduced to $8.93\text{E}-6\text{ A/cm}^2$ ($1.03\text{E}-4\text{ A/cm}^2$ for the substrate). Moreover, the coatings were more difficult to be broken down than the substrate resulting from the formation of SiO₂ and Ta₂O₅ (especially the latter). The average values of breakdown potential (E_{bp}) and pitting resistance (R_{pit}) were enhanced to 0.12 V and $2.21\text{E}5\ \Omega\cdot\text{cm}^2$ (-0.12 V and $1770\ \Omega\cdot\text{cm}^2$ for the substrate). Corrosion resistance of the coatings was further improved by adding TaC into the cladding material because of the formation of Ta₂O₅ on the surfaces of the coatings, including the increase in reaction resistance and the retardation in passive film breakdown. The immersion tests further confirmed this.

Keywords: laser cladding, coating, microstructure, corrosion behavior, oxidation film

1. Introduction

Titanium alloy is known for its excellent corrosion resistance in a variety of industrial fields, such as in navigation, petrochemical industries, medical apparatus, and lining of the chimney [1,2]. The excellent corrosion

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