

## Effect of $\alpha$ -phase on the Corrosion Behavior of Ti-3Al-5Mo-4Cr-2Zr-1Fe Alloy

Renheng Han<sup>1,2</sup>, Yange Yang<sup>2</sup>, Xiaole Han<sup>2</sup>, Yuecheng Dong<sup>3</sup>, Chengzhi Zhao<sup>1</sup>,  
Hexin Zhang<sup>1</sup>

<sup>1</sup>Harbin Engineering University, Harbin, China.

<sup>2</sup>Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China.

<sup>3</sup>Nanjing Tech University, Nanjing, China.

hermitalive@163.com

**Abstract** Ti-3Al-5Mo-4Cr-2Zr-1Fe (Ti-35421) alloy is a newly developed titanium alloy with ideal mechanical properties and lower manufacturing expense. It is well-known that passive film is a main contributing factor to the corrosion resistance of titanium alloys. As the property of passive film is related to the microstructure of alloys, this study aims to investigate the effect of  $\alpha$ -phase on the passive film formation and corrosion behavior of Ti-35421 alloy, exploring a method for the fabrication of low-cost and highly corrosion-resistant titanium alloys.

The as-received material was ingot forged and rolled Ti-35421 alloy. Metalworking and heat treatments were processed to obtain three groups of samples with different  $\alpha$ -phase morphology. The topography and microstructure of samples were characterized using SEM and TEM. The chemical compositions of passive films and corrosion products were analyzed by EDS and XPS. EIS, potentiodynamic polarization, passivation, and transpassivation tests were conducted to investigate the corrosion behavior of samples.

The results show that the corrosion behavior of the Ti-35421 alloy was mainly related to the different morphologies of  $\alpha$ -phase, including  $\alpha_{\text{lamellar}}$ ,  $\alpha_{\text{lath+equiaxial}}$  and  $\alpha_{\text{lath+secondary}}$ . The dimension and appearance of the  $\alpha$ -phase significantly affect the content of  $\text{TiO}_2$  and the segregation of Ti and Al in the passive films. When the  $\alpha$ -phase presented an  $\alpha_{\text{lath+equiaxial}}$  morphology, the highest  $\text{TiO}_2$  content with the lowest Al segregation contributed to the greatest density of passive films and improved corrosion resistance. When the  $\alpha$ -phase presented an  $\alpha_{\text{lamellar}}$  morphology, the lowest content of  $\text{TiO}_2$  and the highest Al segregation made the passive film the least dense and worst corrosion resistance. When the  $\alpha$  phase presented an  $\alpha_{\text{lath+secondary}}$  morphology, the increase of the Fe segregation led to moderate corrosion resistance.

**Keywords** Near- $\beta$  titanium alloy;  $\alpha$ -phase; Passive film; Segregation; Corrosion.