

## Influence of Ni and Nb on corrosion resistance of Ti-6Al-4V alloy for oil and gas development

Xingyu Ou-yang<sup>1,2</sup>, Jinpeng Ge<sup>1,2</sup>, Yang Yu<sup>1,2\*</sup>, Wenjun Ye<sup>1,2</sup>, Songxiao Hui<sup>1,2</sup>

<sup>1</sup> State Key Laboratory of Nonferrous Metals and Processes, China GRINM Group Co., Ltd., Beijing 100088, China

<sup>2</sup> GRIMAT Engineering Institute Co., Ltd., Beijing 101407, China

**Abstract** In this paper, the electrochemical properties, passivation film characteristics and corrosion resistance of Ti-6Al-4V-xNi-xNb alloy in 1mol/L hydrochloric acid solution were studied, and the mechanism of the effect of alloying elements on the corrosion resistance of the material was revealed. The results are as follows: Among Ti-6Al-4V-0.5Ni, Ti-6Al-4V-0.5Nb, Ti-6Al-4V-0.5Ni-0.5Nb and Ti-6Al-4V-0.5Ni-1Nb, the titanium alloy with Ni added has higher corrosion potential and lower corrosion current in hydrochloric acid solution. The passivation current density of titanium alloy with Nb is improved. The corrosion loss results show that the corrosion rate of the alloy after adding Ni element is not more than 0.001mm/a, which is a slight corrosion. TC4-0.5Nb shows a large corrosion loss and loss rate at the initial corrosion stage, and the corrosion rate gradually decreases and tends to be flat with the extension of soaking time, which is because the oxide of Nb plays a certain stabilizing role in the newly formed passivation film on the alloy surface, hindering the further corrosion. The corrosion resistance mechanism of Ni-Nb composite modified titanium alloy was studied. It was found that the addition of Ni significantly increased the passivation film thickness of the alloy while increasing the electrode potential of the alloy, and the oxides formed by Nb also played a certain stabilizing role in the passivation film, thus effectively reducing the dissolution of the surface passivation film.

**Keywords** Corrosion resistance, Petroleum pipeline, Passivation film