Evaluation of microbiologically influenced corrosion of Ti6-Al4-V (TC4) alloy in the marine oil industry

Zixuan Xu[1], Tiansui Zhang[1], Guangfang Li[1], Hongfang Liu[1, *]

1Key Laboratory of Material Chemistry for Energy Conversion and Storage, Ministry of Education, Hubei Key Laboratory of Material Chemistry and Service Failure, Hubei Engineering Research Center for Biomaterials and Medical Protective Materials, School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, Wuhan 430074, P. R. China

E-mail address: xzx363318116@163.com (Z. Xu, Presenter)

Abstract Titanium alloy, as an excellent lightweight alloy, has a promising application in the marine oil industry. However, they are not immune to SRB erosion. SRB biofilm can colonize the surface of TC4 alloy well and trigger severe MIC and localized corrosion. The addition of riboflavin significantly unaffected the SRB planktonic and sessile cell counts, but enhanced the biofilm thickness slightly. Hilbert-Huang transform showed that corrosion pits on the surface of TC4 alloy was triggered by SRB biofilm and enhanced by riboflavin. The maximum corrosion pit depths in biotic medium with 0 ppm, 20 ppm, and 50 ppm riboflavin reach 5.71 μm, 6.38 μm, and 6.65 μm, respectively. The lower R_{ct} values were associated with riboflavin, which shuttled electrons from the metal surface to SRB cells. Mott-Schottky curves showed the property of n-type semiconductor oxide films on the surface of TC4. The higher N_D values in biotic medium with electron shuttle demonstrated that SRB cells promoted by riboflavin-shuttle contributed to more passivation film defects on the surface of TC4 alloy and weakened the oxide film. MIC could influence the alloy phase composition, grain size and organization.

Keywords Ti-6Al-4V (TC4); Microbiologically influenced corrosion (MIC); Biofilm; Corrosion pits; EBSD

Reference

[1] Zixuan Xu, Fei Zhang, Tiansui Zhang, Jianbo Wang, Junqiang Wang, Renyang He, Fei Li, Wei Sun, Hongfang Liu, Unique corrosion reinforcement mechanism of pipeline oil sludge with sulfate-reducing bacteria on X60 steel and the targeted long-term inhibition of dazomet delivery, *Corrosion Science*, 228, 2024, 111792.

[2] Zixuan Xu, Tiansui Zhang, Huihai Wan, Ying He, Junqiang Wang, Renyang He, Hongfang Liu, Electrochemical investigation of the “double-edged” effect of low-dose biocide and exogenous electron shuttle on microbial corrosion behavior of carbon steel and copper in enriched seawater, *Electrochimica Acta*, 476, 2024, 143687.