QUANTIFICATION OF THE SYNERGY EFFECTS BETWEEN WEAR AND CORROSION OF 316L STAINLESS STEEL IN DEEP-SEA ENVIRONMENT

Pengwei Ren, Huimin Meng *, Qijun Xia, Yuchao Wang, Mingtao He

*menghm16@126.com

Corrosion and Protection Center, Institute for Advanced Materials and Technology, University of Science and Technology Beijing, 100083, China

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ABSTRACT

Under deep-sea environment, the correlation between tribocorrosion and seawater hydrostatic pressure, i.e., seawater depth, is an important issue for the increasing deep-sea engineering[1]. In this study, corrosion and wear of 316L stainless steel were investigated under simulated deep-sea environment concerning seawater hydrostatic pressure using a pin-on-disc tribometer integrated with a high-pressure autoclave for keeping hydrostatic pressure constant and an electrochemical workstation for potential control. It is found that solution hydrostatic pressure and electrode potential have significant effects on the corrosion and wear behaviour of 316L stainless steel. The polarization curves under static (no wear) conditions revealed that corrosion current density increased with increase in solution hydrostatic pressure. The tribocorrosion tests within different solution hydrostatic pressure were conducted under open circuit potential (OCP) and potentiostatic conditions. The cathodic shift of OCP and the enhancement of anodic current occurred during sliding due to mechanical depassivation within wear track[2]. Meanwhile, wear morphology and wear volume were analysed using scanning electron microscopy (SEM) and non-contact scanning laser profilometry respectively. SEM analysis demonstrated that the wear mechanism, independent of solution hydrostatic pressure, is characterized by plastic deformation, adhesive wear and abrasive wear. Wear volume increased with the increasing applied potential in a form of first-order exponential function, and the significantly larger volume loss was observed under higher solution hydrostatic pressure. Moreover, the quantification of synergistic effects in terms of standard ASTM G119-09[3] showed mechanical wear and synergistic term are major components. Remarkably, the synergistic effects increase with the electrode potential and solution hydrostatic pressure, and the corrosion-induce wear is dominant in the synergism.

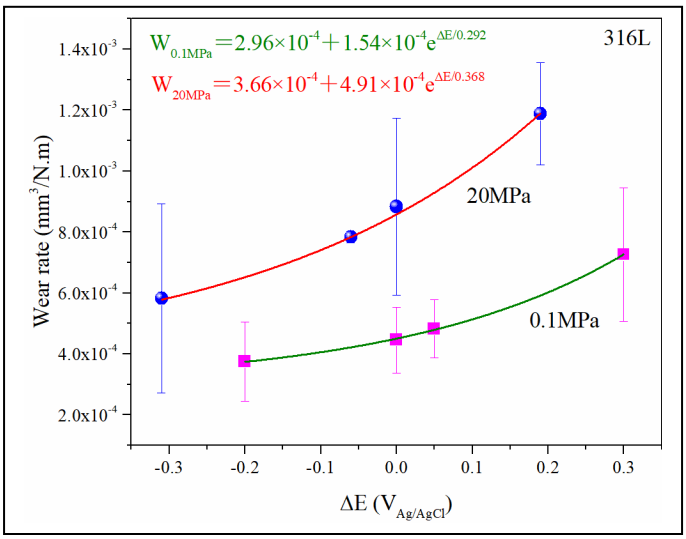

Fig.1 Dependence of wear rates of 316L stainless steel on the value of polarization at different hydrostatic pressures.

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