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Abstract

PASSIVATION OF STAINLESS STEEL FOR MEDICAL
APPLICATIONS

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Chemical passivation of one biomedical alloy (austenitic stainless steel AISI 316L) and one surgical instruments alloy (martensitic stainless steel AISI 440C) was carried out in nitric acid and citric acid solutions under various treatment conditions such as processing time, temperature and concentration of the solution. Elemental identification and depth profiles of composition of the passivated surfaces were analyzed by X-ray Photoelectron Spectroscopy (XPS). The corrosion behavior of the passivated stainless steels in 0.9 wt% NaCl solution at 37 °C were studied by open circuit potential measurement and potentiodynamic polarization technique. The effects of processing time, temperature and concentration of the solutions on the corrosion characteristics such as open circuit potential (E_{corr}), pitting potential (E_{pit}) and corrosion current (i_{corr}) of the steels are studied by orthogonal method. The optimized passivation conditions of the chemical passivated stainless steels were obtained by $L_9 (3^3)$ orthogonal design analysis for achieving the best corrosion performance. In general, temperature is found to be the most significant factor in affecting the ultimate corrosion performance of the passivated stainless steels. In addition, the results show that passivation by nitric acid is more effective in improving the corrosion resistance of both 316L and 440C than by citric acid. XPS analysis showed that the outer layers of the passivated stainless steels by both nitric and citric acid solutions were mainly composed of the oxides such as $\text{Cr}(\text{OH})_3$, Cr_2O_3 , FeO and Fe_3O_4 . Compared with untreated stainless steels, the passivated ones show significant increase in the Cr/Fe ratios for forming a thicker and more tenacious oxide film for

improving their corrosion resistance in simulated body environment.