Evaluation of Immersion Time Effects on the Corrosion Resistance of Chromized layer on 430 Stainless Steel in 1M HCl Solution

S. Djemmah[1], D. Allou [2], A. Mameri [3], M. Voué [1]

[1]University of Mons, Physics of Materials and Optics Unit (LPMO), Research Institute for Materials Science and Engineering, Mons, 7000, Belgium.

[2] Research Center in Industrial Technologies (CRTI), Algiers, 16014, Algeria.

[3] Semiconductors Technology for Energetic Research Center (CRTSE), Algiers, 16038, Algeria

To enhance the application of 430E stainless steel in corrosive and aggressive environments, a doped Cr-rich layer of 24 µm was performed on 430E stainless steel through pack chromizing. The analysis was deposited by using electrochemical impedance spectroscopy (EIS) in an aggressive HCl solution, over varying immersion times (0, 1, 4, 6, and 8 days) at ambient temperature (25 ±1 ° C). Morphology and corrosion products were assessed using electron probe microanalysis (EPMA). The results of potentiodynamic polarization analysis indicate that the corrosion resistance of the Cr-layer decreases with increased immersion time. Despite this, the corrosion potential (E_{corr}) became more positive after 8 days of immersion in 1M HCl solution, suggesting the formation of a protective corrosion product layer. Usually, higher Cr concentration could move the corrosion potential to a more positive direction indicating surface's resistance. EIS measurements revealed that samples with shorter immersion times (0, 1, and 4 days) exhibited higher charge transfer resistance and better corrosion resistance. The chromizing process ensured corrosion resistance, particularly during the initial immersion period, and maintained the stability of the chromized layer for up to 6 days post-immersion. Although corrosion resistance seemed diminished after 8 days, no substantial amounts of oxidation products, contaminations or severe layer degradation were detected by EPMA analysis.

Keywords: 430E stainless steel, Doped Cr-rich layer, 1M HCl solution, Electrochemical impedance spectroscopy (EIS), Corrosion resistance.