Electrochemical Mechanism of Microporous Autocatalytic Surface Formation on a High-Chromium Alloy in an Alkaline Solution

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An experimental and analytical investigation of the formation of a microporous layer of mixed ferric oxide and ferric hydroxide on a high-chromium alloy in alkaline solution under the oxygen evolution region is presented. By potentiostatic polarization under 5 V_{Ag/AgCl}, a dark red microporous layer was formed on the surface of the high-chromium alloy. The workpieces and electrolytes were examined and analyzed by scanning electron microscopy (SEM), X-ray fluorescence (XRF), Raman microscopy (RMS) and inductively coupled plasma (ICP) to probe the electrochemical mechanism of layer formation. The results demonstrate that under the set conditions, Fe(VI) ions were generated from the anode. However, due to the consumption of OH⁻ ions, Fe(VI) ions were decomposed into ferric hydroxide; in turn, ferric hydroxide had an autocatalytic effect on the decomposition of Fe(VI) ions. The anodic reaction steps were controlled by the mass transfer of OH⁻ ions, and alternative transformation between Fe(VI) ions and ferric hydroxide accelerated the formation of a microporous layer.

Keywords: High-chromium alloy; Autocatalytic effect; Anodic reactions; Electrochemical deposition

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