Interaction Mechanism between Zn and Passivated Stainless Steel

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This study investigated the interaction between solid Zn and passivated stainless steel. The effect of passivation film on the interaction mechanism of Zn and stainless steel surface was determined. The cross section morphology and the chemical compositions of the intermetallics (IMC) were detected by scanning electron microscopy (SEM) and energy dispersive X-ray spectrometer (EDX). The composition and integrity of the passivation films were identified by X-ray photoelectron spectroscopy (XPS) and Mott-Schottky electrochemical analysis. Results showed that solid Zn reacted with stainless steel by forming interfacial columnar δ phase (Fe, Cr, Ni)Zn₁₀ with tiny granule ζ phase (Fe, Cr, Ni)Zn₁₃ IMCs. The reaction was hindered by the chemical passivation film and the native oxide film grown in air; the influence of the former is significantly higher than that of the latter. The passivation films were composed of Fe-rich and Cr-rich oxides and hydroxides. The chemical passivation film was richer in Cr oxides and hydroxides and had higher integrity than the native oxide film. The IMCs formed between the low-melting-point-metal and stainless steel can be attributed to the incomplete passivation films, which impeded the compound layer growth to some extent. The passivation film served as a physical barrier between solid Zn and stainless steel.

Keywords: Solid Zn, Stainless steel, Passivation, XPS, Mott-Schottky

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