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Extended abstract

EXTENDED ABSTRACT

In-line digital holography for the study of localized corrosion and dynamic processes of electrochemical reactions•

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Abstract: Digital holographic reconstruction has been used to map the transient concentration field within the diffusion layer, detect the dynamic processes of localized corrosion, such as pitting corrosion, crevice corrosion and scratch corrosion crack. It has been used with an attempt to identify the actual mechanism through observing the dynamic changes of the diffusion layer near the electrode/electrolyte interface during anodic processes of copper.

Keywords: digital holographic reconstruction; concentration change; diffusion layer; localized corrosion.

Digital holography is a new technique applied in electrochemistry and corrosion science. It has many advantages compared with traditional photographic holography.[1] In digital holography, holograms are recorded by a CCD camera and image reconstruction is performed by a computer. It saves the trouble of photographic processing and delivers the distributions of both intensity and phase directly.[2,3] Since the distributions of not only intensity but also phase can be calculated, object displacement can be directly detected from the difference of the reconstructed phases before and after object deformation.[4,5]

In our laboratory, digital holographic reconstruction has been employed in studies of dynamic changes of the concentration and the diffusion layer and for the detection of some types of localized corrosion.

a) Digital holographic reconstruction was employed in studies of the dynamic changes of the concentration and diffusion layer at the $Cu/CuSO_4$ interface. A two-dimensional concentration distribution was presented to illustrate the diffusion layer and the concentration changes.[5]

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b) It was used to observe the dynamic pitting processes of X70 carbon steel in neutral solution containing chloride ions.[6] It was employed in an attempt to identify the actual mechanism through observing the dynamic changes of the diffusion layer at the electrode/electrolyte interface during the anodic processes of copper in 0.5 mol dm^{-3} NaCl solution.[7] The results confirmed that in the initial stage, the cuprous ion is formed first, which then reacts to produce cuprous chloride and/or cuprous chloride-complexes. The two-dimensional concentration images were also used to study the dynamic concentration changes during current oscillations in an acidic solution of iron.

c) Recently, the dynamic processes of crack corrosion during the anodic dissolution of a cracked electrode in a 0.5 mol dm^{-3} NaCl solution[8] were investigated. The localized scratch-induced corrosion process of Alloy 690 in 0.5 mol dm^{-3} H_2SO_4 containing 0.1 mol dm^{-3} NaCl solution[9] and stress corrosion cracking of stainless steel have also been studied by digital holographic reconstruction. This method was shown to be an effective *in situ* technique for detecting changes in concentration at the interface of localized corrosion regions.

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ИЗВОД

IN-LINE ДИГИТАЛНА ХОЛОГРАФИЈА ЗА ИСИТИВАЊЕ ЛОКАЛИЗОВАНЕ КОРОЗИЈЕ И ДИНАМИЧКИХ ПРОЦЕСА У ЕЛЕКТРОХЕМИЈСКИМ РЕАКЦИЈАМА

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Приказано је коришћење дигиталне холографске реконструкције за мапирање транзијентног концентрационог поља унутар дифузионог слоја и за детекцију динамичких процеса локализоване корозије, као што су питинг корозија, корозија у пукотинама и корозија у огреботинама. Помоћу ове методе праћене су динамичке промене дизузионог слоја на граници фаза електрода/електролит у циљу успостављања механизма анодних процеса на бакру.

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