Abstracts

The kinetics of passivation of Cr, Ni and 304 stainless steel in solutions of pH 2 containing H₂SO₄ (6.5 x 10⁻³M) and KC₁ (0 - 1M) have been studied under potentiostatic conditions by means of potential-stepping and scratching techniques. A straining electrode technique has also been employed for the stainless steel. Apart from the H₂SO₄-containing solutions, a 10⁻² HC₁, pH 2 solution was used in the experiments with stainless steel. Most of the current-decay curves follow a log I vs. log t relationship with a negative slope, -b, which is dependent on solution composition, applied potential and, for the passivation of stainless steel by the potential-step method, on the pre-anodic treatment. Important deviations from this simple law were observed for some of the potential-stepping transients obtained for stainless steel, namely when cathodic polarization and short open-circuit exposures were used prior to passivation. XPS analyses revealed that appreciable changes in the surface composition of the stainless steel specimens occurred during open-circuit exposure, prior to the application of the passivation potential. For the straining experiments and for scratching experiments performed at a slow rate a complex behaviour pattern of the passivating current was also found. The shape of the curves was, however, successfully predicted by a model based on film growth considerations.

For stainless steel low rates of passivation, measured by the constant b, were observed near the active-passive transition region and near the pitting potential. Both were associated with pitting. For Ni low rates of passivation, observed near the active-passive transition region, were not associated with pitting. Furthermore, a deceleration in the rate of passivation was not observed in the vicinity of the pitting potential. Both for Ni and stainless steel the pits did not nucleate preferentially along the scratch lines, which was taken as an indication that the rate of passivation does not control the pitting behaviour of the systems studied. Optical, S.E.M. and electron microprobe studies suggest that the pits nucleate at non-metallic inclusions. The scratching technique did not provide an accurate way to determine the pitting potential of the materials.