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Stability study of passive film on copper surface as a function of anodic potential

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Abstract: Results for passive film formation and breakdown on copper disk electrodes in buffer solutions, pH 9.2 and 8.5, were reported earlier. The present studies were carried out in a buffer solution, pH 8.0, and together these studies make good material for understanding the effect of pH changes on film texture as a function of potential. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were used to examine passive film and the variations it went through upon being treated potentiostatically in the range of -0.3 to 0.9 V. On the basis of equivalent circuits used for modeling impedance data in this potential range, 4 stages were identified. The proposed circuits for different potential ranges illustrated the Cu/oxide/electrolyte systems and their properties in terms of 2 interfaces. A criterion for the applicability of the equivalent circuit model was discussed. Changes in the film-metal interface as a function of potential were also probed at 30 mHz with Nyquist plots. Diffusion coefficients for ionic movement at 4 potential values in the film, calculated from the EIS data, were of the order of 10^{-5} cm^2 s^{-1}.

Key Words: Electrochemical impedance spectroscopy, model circuits, copper surface, passive film, transition stage, interfaces, diffusion coefficient

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