

Turkish Journal of Chemistry

Turkish Journal

of

Chemistry

A study of growth and breakdown of passive film on copper surface by electrochemical impedance spectroscopy

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Abstract: Electrochemical impedance spectroscopy (EIS) and cyclic voltammetry were used to investigate the oxide layer formed on a copper disc electrode and the changes that took place when treated potentiostatically in the range of -0.3 V to 0.9 V in aqueous buffer solution of pH 9.2. Equivalent circuits were used to model the response of the electrode, initially at equilibrium to an applied potential. These circuits were proposed for different potential ranges in order to illustrate the Cu/oxide/electrolyte system and its properties in terms of 2 interfaces. A criterion for the applicability of equivalent circuit models was discussed. Changes in the film/metal interface as a function of potential were probed at 30 mHz from Nyquist plots. Diffusion coefficient calculated for the ionic movement in the film at 2 potential values using EIS data was of the order of $10^{-9} \text{ cm}^2 \text{ s}^{-1}$.

Key Words: Copper, electrochemical impedance spectroscopy, cyclic voltammetry, passive film, interfaces.

Turk. J. Chem., **33**, (2009), 739-750.

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