Electrochemical Characterization of Nickel in Oxalic Acid Solutions and the Effect of Halides and Azide Ions Additions on Its Behavior

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The electrochemical behavior of polycrystalline nickel in aqueous oxalic acid solutions was thoroughly investigated using different electrochemical techniques. Open circuit potential (OCP) transients of Ni electrode indicate different natural tendencies for the metal to modify its pre-immersion native film in oxalic acid medium depending on its concentration and temperature. In agreement with the OCP results, electrochemical impedance spectroscopy (EIS) clearly demonstrates that surface film resistance (R_f) on Ni increases with concentration over the range 0.01-0.5 M, but decreases with raising temperature. Also, linear sweep voltammetry (LSV) was used to compare at similar experimental conditions hydrogen evolution reaction (HER) on nickel cathode to that on platinum which has high catalytic activity towards HER. Furthermore, addition of different sodium halides or azide to 0.5 M oxalic acid solution (blank) was found to increase the propensity of nickel to dissolution in the following order: $I^- < F^- < \text{blank acid} < Cl^- < Br^- < N_3^-$ (the most aggressive). These findings are discussed based on the kosmotrope/chaotrope nature of the added anions and further validated by SEM examination.

Keywords: Nickel metal; Oxalic acid; Halides; Azide ions; EIS; LSV; SEM; Film resistance.

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