A Theoretical Model for Metal Cation Reduction in the Flow Field and Its Application to Copper Electrorefining

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This paper studies the kinetic process of cation discharge in the flow field of a forced-flowing electrolyte during copper electrorefining. Through electrochemical methods such as rotating disk electrodes, linear sweep voltammetry curves and cathodic polarization curves, the diffusion coefficient (D), reaction rate constant (k^0), transfer coefficient (α) and other electrochemical parameters were obtained. A theoretical model revealing the mass transfer and discharge process of cations in the copper electrolyte was established. This model can be used to analyze the reduction behavior of Cu^{2+} and Bi^{3+} at the surface of the cathode and give the theoretical influence of various electrolysis factors on the purity of the cathode copper. The actual electrorefining experiments confirmed that the variation regularity of copper purity is consistent with the theoretical model. Meanwhile, optimized copper electrorefining experiments were conducted in the simulated industrial electrolyte according to theoretical analysis results with high impurity concentration, by which the purity of the cathode copper reached 99.995%.

Keywords: copper electrorefining, diffusion coefficient, flow field, theoretical model

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