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current distribution

Also contains definitions of: current density (relative local), primary current distribution, relative local current density, secondary current distribution, tertiary current distribution, throwing power, Wagner number

The ratio of current density at a point X on an interface to the average current density ($\frac{j_x}{j}$) is called the relative local current density. The current distribution is described by the function $\frac{j_x}{j} = f(x)$ (or more generally, $\frac{j_x}{j} = f(x, y, z)$ where x or (x, y, z) are the coordinates of the points of the electrode-solution interface. The primary current distribution is that which establishes itself when the influence of overpotential is negligible. The secondary current distribution is that which establishes itself when the influence of the overpotential cannot be neglected but concentration overpotential is negligible. The secondary distribution is often described in terms of dimensionless numbers of the form

$$\mathrm{Wa} = \frac{\kappa}{l}\frac{\mathrm{d}\eta}{\mathrm{d}j}$$

where κ is the conductivity of the solution, $\frac{\mathrm{d}\eta}{\mathrm{d}j}$ the slope of the overpotential-current curve under the above conditions and l a characteristic length of the system, for instance the radius of a disc electrode. Wa is the Wagner number. It is a quantity which determines the throwing power and characterizes the equalizing influence of overpotential on the current distribution. In electroplating the throwing power is qualitatively defined as 'the ability of a solution to deposit metal uniformly upon a cathode of irregular shape'. The tertiary current distribution is that which establishes itself when the influence of the overpotential (including concentration overpotential) cannot be neglected.

Source:
PAC, 1981, *53*, 1827 *(Nomenclature for transport phenomena in electrolytic systems)* on page 1836

