circuit have the form $Z = A(j\omega)^{-n}$, where A and n are constants [18]. Components 1, 2, and 4 represent the electronic resistance of the cathode, the impedance of the electrolyte, and the impedance of the cathode, respectively. The latter was assumed to have the form similar to Randles [19]. . In this model, R_d is usually called the charge transfer resistance, Z_w the diffusion impedance, and Z_{dl} the impedance of the double layer at the cathode-electrolyte interface. For Z_{el}, Z_i, and Z_{dl}, the frequency exponent n is on the order of 0.8. For the Warburg term, Z_w, n = 1/2. The origin of component 3 in the model is not known at this time, but it is associated with the formation of the Lipon-V_2O_5 interface. All four of the equivalent circuit components also appear in the impedance spectra of a V/Lipon/V_2O_5/V thin-film structure, so component 3 is not due to the Li-electrolyte interface. Moreover, this component does not appear in the impedance spectra of a Li-$Li_xMn_2O_4$ cell nor that of a Li-TiS_2 cell.

Ho et al. [20] extended Randles' model to intercalation cathodes and obtained a relationship between the constant A_w and the chemical diffusion coefficient $\tilde{D}_i$ for the cations in the cathode:

$$A_w = \frac{V_m \, dV/dx}{\sqrt{2}\, Fa} \cdot \frac{1}{\sqrt{\tilde{D}_i}} \tag{2}$$

where dV/dx is the derivative of the cell potential with the change in the cation stoichiometry parameter, e.g., x in $Li_xV_2O_5$, V_m is the molar volume, F is Faraday's constant, and a is the area of the cathode. The diffusion coefficients given in Table 2 were calculated by from Eq. (2) using the fitted values of A_w, V_m = 54.1 cm^3/mol (crystalline value), and dV/dx = 0.75 V. These are effective diffusion coefficients which include not only the ionic mobility and thermodynamic enhancement factors but also the film microstructure. By comparison, Baudry et al. [21] reported a diffu-