

# **Time-Fractional Approach to the Electrochemical Impedance: The Displacement Current**

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**Abstract:** We establish, in general terms, the conditions to be satisfied by a time-fractional approach formulation of the Poisson-Nernst-Planck model in order to guarantee that the total current across the sample be solenoidal, as required by the Maxwell equations. Only in this case the electric impedance of a cell can be determined as the ratio between the applied difference of potential and the current across the cell. We show that in the case of anomalous diffusion, the model predicts for the electric impedance of the cell a constant phase element behavior in the low frequency region. In the parametric curve of the reactance versus the resistance, the slope coincides with the order of the fractional time derivative.