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The Equivalent Electrokinetic Circuit Model of Ion Concentration Polarization Layer: Electrical Double Layer, Extended Space Charge and Electro-convection INHEE CHO, KEON HUH, Seoul National University, RHOKYUN KWAK, Korea Institute of Science and Technology, HYOMIN LEE, SUNG JAE KIM, Seoul National University — The first direct chronopotentiometric measurement was provided to distinguish the potential difference through the extended space charge (ESC) layer which is formed with the electrical double layer (EDL) near a perm-selective membrane. From this experimental result, the linear relationship was obtained between the resistance of ESC and the applied current density. Furthermore, we observed the step-wise distributions of relaxation time at the limiting current regime, confirming the existence of ESC capacitance other than EDLs. In addition, we proposed the equivalent electrokinetic circuit model inside ion concentration polarization (ICP) layer under rigorous consideration of EDL, ESC and electro-convection (EC). In order to elucidate the voltage configuration in chronopotentiometric measurement, the EC component was considered as the dependent voltage source which is serially connected to the ESC layer. This model successfully described the charging behavior of the ESC layer with or without EC, where both cases determined each relaxation time, respectively. Finally, we quantitatively verified their values utilizing the Poisson-Nernst-Planck equations. Therefore, this unified circuit model would provide a key insight of ICP system and potential energy-efficient applications.

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