Challenges Facing Lithium Batteries and Electrical Double-Layer Capacitors

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Supporting Information

If the total resistance of both EDLC electrodes is identical, then when the EDLC is charged the potential of the negative and positive electrodes will be changed by the same value and, in ideal case, will approach $V_{\text{low stable}}$ and $V_{\text{high stable}}$, respectively (Figure S1a). In this ideal case, the maximum EDLC voltage $V_{\text{max EDLC}}$ can approach the maximum electrolyte stability $\Delta V_{\text{max electrolyte}} = V_{\text{high stable}} - V_{\text{low stable}}$. In a non-ideal case, however, one of the electrodes reaches the boundary of the allowed potential window faster than the other. In this case the highest voltage applicable to the EDLC $V_{\text{max EDLC}}$ will be lower than $V_{\text{max electrolyte}}$. By doping one or both electrodes, however, one may change their corresponding potential in the EDLC fully discharged state in such a way as to maximize EDLC voltage $V_{\text{max EDLC}}$ (Figure S1b).

Figure S1. Schematic energy diagram of a) regular and b) doped EDLC electrodes upon charging relative to the electrolyte stability window. Doping of one of the electrode may compensate for the difference in the resistance between cathode and anode, and therefore increase the maximum operational voltage of an EDLC.