*Supporting Information for*

Building better dual-ion batteries

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Gravimetric $C\_{e}=\frac{Fx(M\_{d}-M\_{c})}{10^{3}ρ}$ (mAh g−1) (S1)

Volumetric $C\_{e}=\frac{Fx(M\_{d}-M\_{c})}{10^{3}}$ (mAh mL-1) (S2)

$F=26.8×10^{3} $mAh mol−1 (Faraday constant), $M\_{d}$ and $M\_{c}$ are molarities (mol L−1) of the electrolyte in discharged ($M\_{d}$) and charged ($M\_{c}$) state of the battery, $ρ$ is the density of the electrolyte in g mL-1 and $x$ is the charge of the electroactive species in the electrolyte ($x$ = 1 for systems comprising monovalent ions).

Gravimetric $C\_{an}=\frac{Fx(r-1)}{rM\_{AlCl\_{3}}+M\_{XCl}}$ (mAh g−1) (S3)

Volumetric $C\_{an}=\frac{Fx(r-1)ρ}{rM\_{AlCl\_{3}}+M\_{XCl}}$ (mAh g−1) (S4)

$M\_{AlCl\_{3}}$ is the molar mass of AlCl3 in g mol-1, $M\_{XCl}$ is the molar mass of Cl- source (for example 1-ethyl-3-methylimidazolium chloride, 1-butyl-3-methylimidazolium chloride orHCl in the simplest case) in g mol-1, $r$ is the AlCl3:XCl molar ratio and $ρ$ is density of the chloroaluminate-based anolyte in g mL-1.



**Figure S1.** Schematic of the charging and discharging processes of Al DIB.