Supporting information on

Electrochemical stability of non-aqueous electrolytes for sodium-ion batteries and their compatibility with $Na_{0.7}CoO_2$

Amrtha Bhide[1]*, Jonas Hofmann[1], A. K.Duerr[2], Jürgen Janek[1], Philipp Adelhelm[1]*

1 Institute of Physical Chemistry, Justus-Liebig-University Giessen
Heinrich-Buff-Ring 58, 35392 Giessen, Germany.
2 BASF SE, 67056 Ludwigshafen,Germany

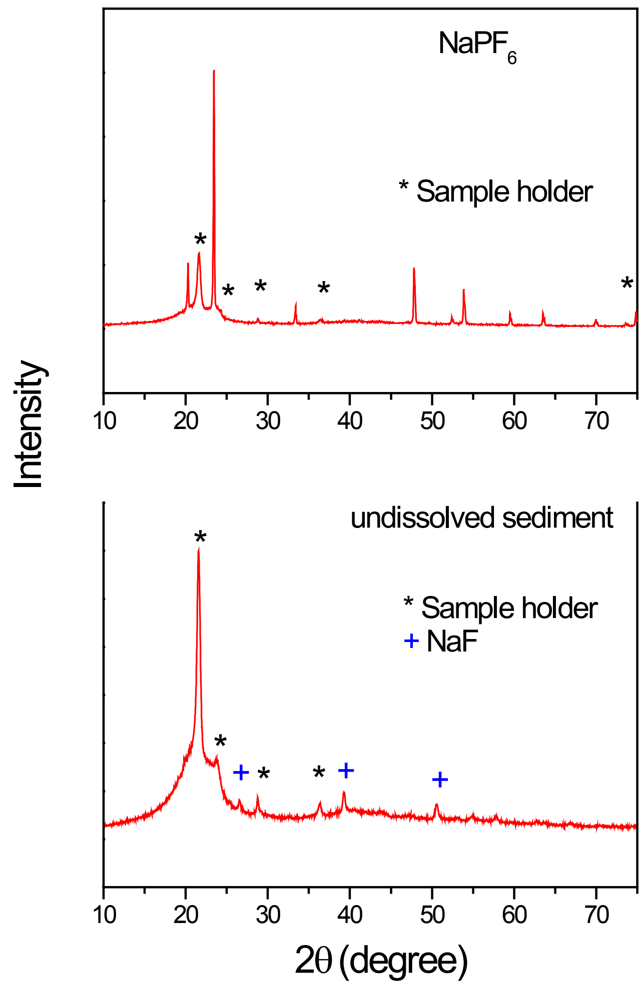


Figure S1 XRD of $NaPF_6$ salt and the undissolved sediment

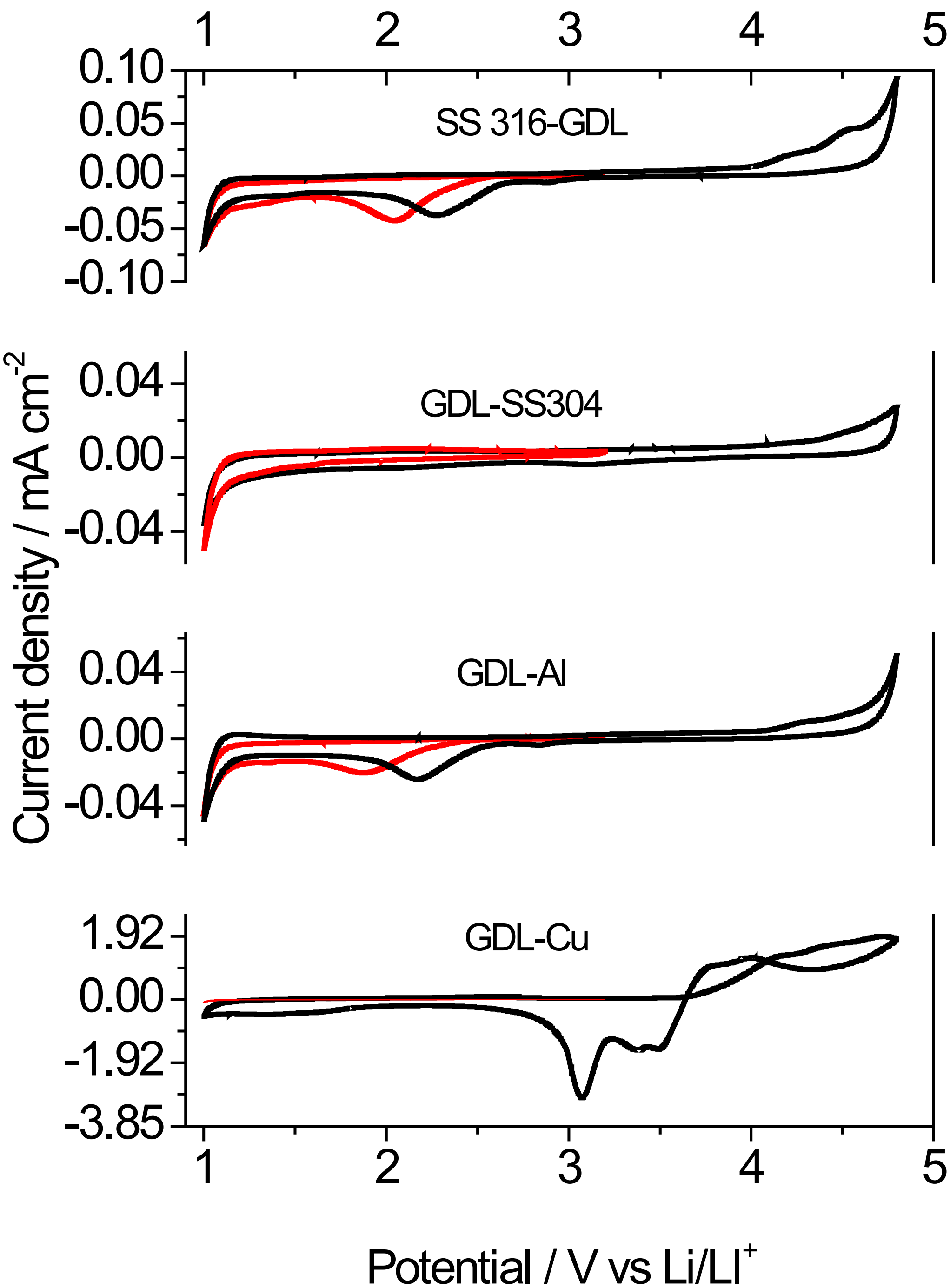
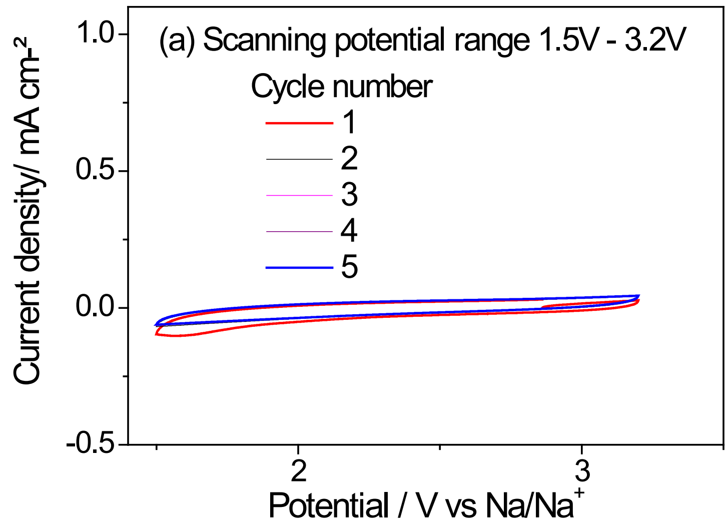


Figure S2 CV and stability of LP30 with respect to current collectors



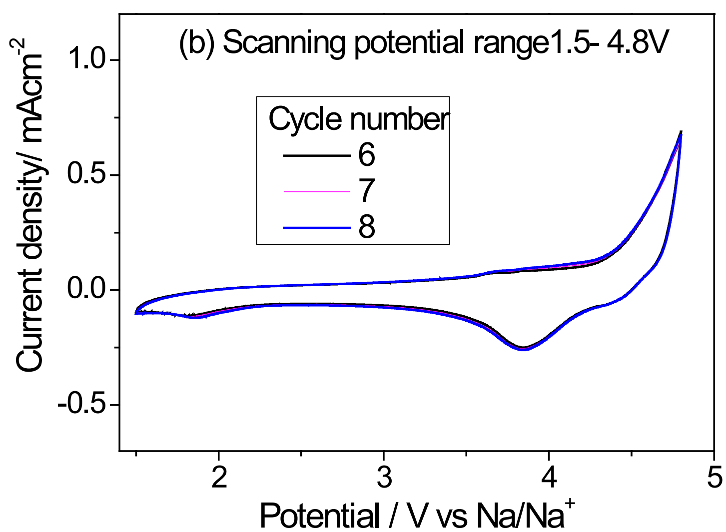


Figure S3 Cyclic voltammograms obtained for three electrode Swagelok cells containing 0.5 M $NaPF_6$ electrolyte with respect to graphite (a) first few cylces over with narrow potential range (b) consecutive scans over wider potential range

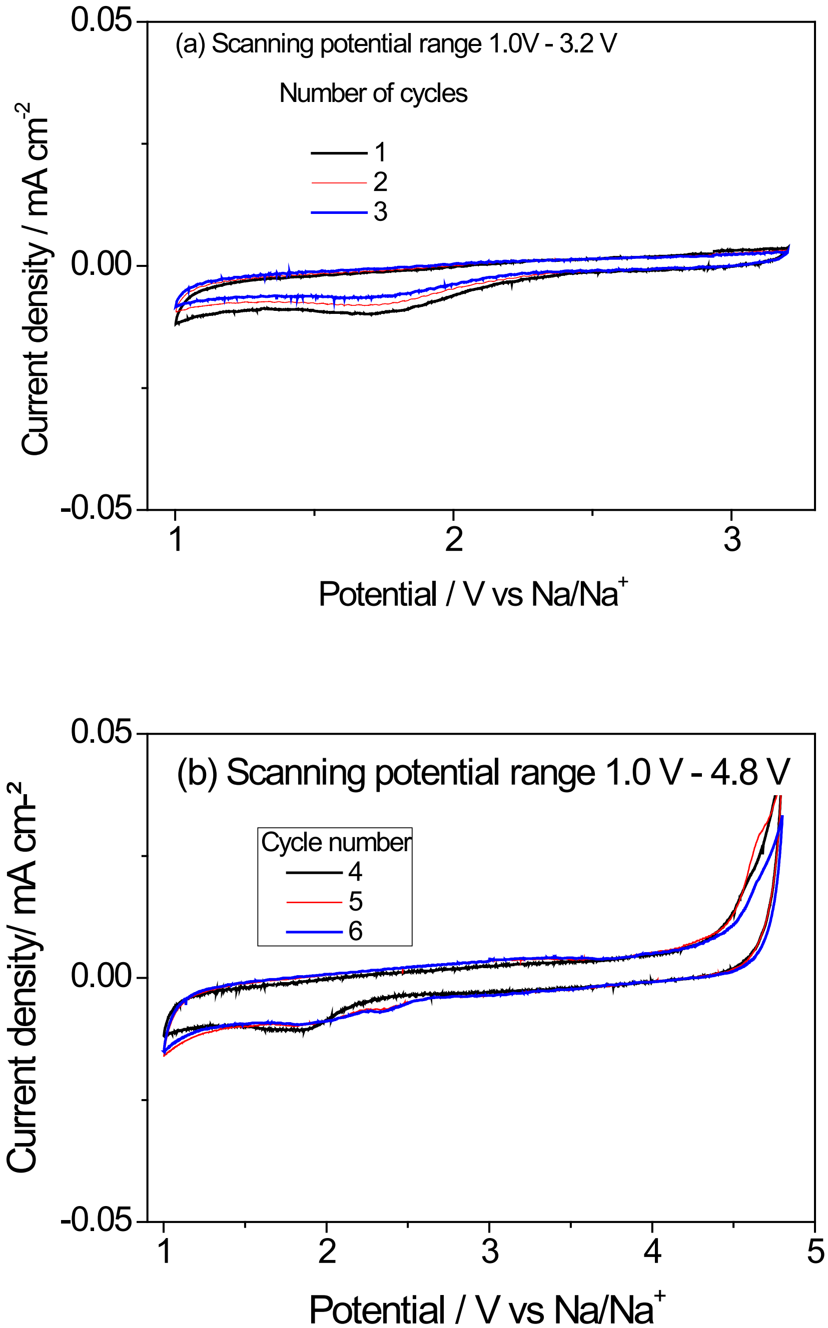
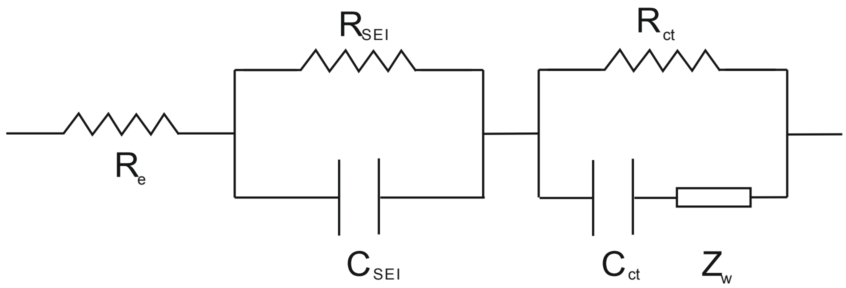


Figure S4 Stability of 0.5 M $NaPF_6$ electrolytes in the cells utilizing GDL as working electrode along with SS304 current collector (a) first few scans over narrow potential range (b) consecutive sweeps over wide potential range



$NaPF_6$:EC:DMC	R_{SEI}	R_{ct}
OCV	35.2	99.3
Cycle1	86.3	116.1
Cycle 2	89.3	121.2
Cycle 3	92.2	125.3
Cycle 4	94.2	129.3
Cycle 5	97.2	132.3

NaOTf	R_e	R_{SEI}	R_{ct}
OCV	32.5	54.1	70.8
Cycle1	28.2	55.9	76.4
Cycle 2	-	88.2	142.0
Cycle 3	-	92.1	149.1
Cycle 4	-	148.2	202.3
Cycle 5	-	155.2	267.1

$NaClO_4$	R_{SEI}	R_{ct}
OCV	58.2	149.9
Cycle1	112.2	210.3
Cycle 2	115.6	215.7
Cycle 3	122.3	279.4
Cycle 4	138.3	320.2
Cycle 5	147.2	339.4

Figure S5 Equivalent circuit model used for analyzing the impedance data presented in Figure 9(b) and numerical values of the equivalent circuit components obtained for the impedance data. In the case of NaOTf, values for R_e could not be derived after the second cycle, because drastic increment in the R_{SEI} and R_{ct} values after the second cycle leads to a loss of information on the ionic conductivity.

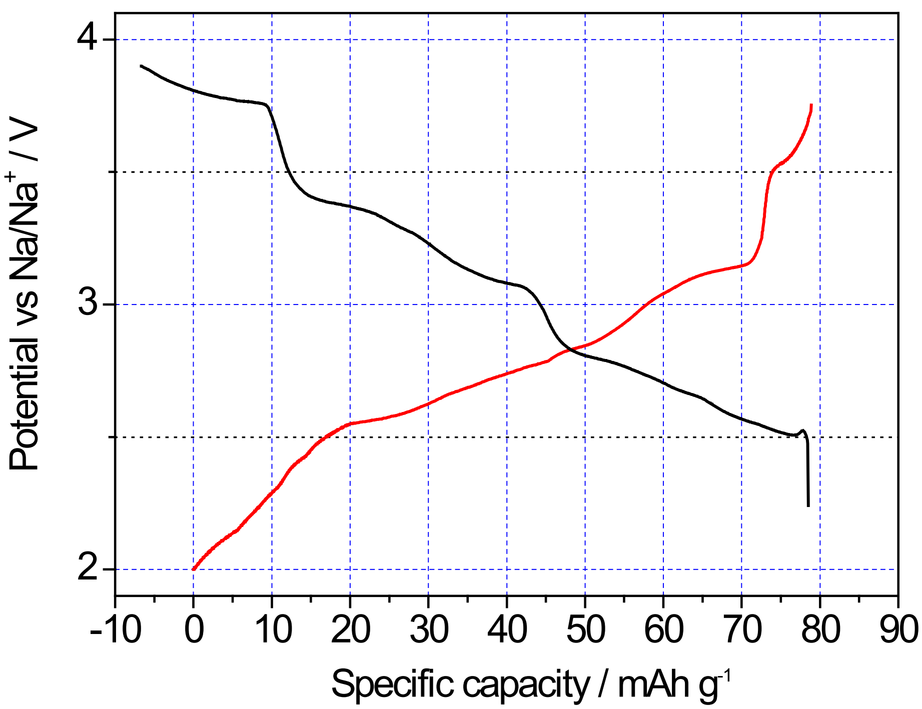


Figure S6 A typical charge-discharge curves of the Na/$NaCoO_2$ cell utilizing 0.5 M $NaPF_6$ in EC:DMC (30:70 wt.%)

	$NaPF_6$	$NaClO_4$	$NaCF_3SO_3$	NaTFSI
Purity (%)	99.0	98.0	98.0	N.A
Drying process (°C, h)	~ 120 (24h)	~80 (24 h)	~120 (24h)	120 (48h) 180 (16h)
Ther. stability Melting point (°C)	450 400	130 -	400 258	380 263
Water content	< 5 ppm	< 5 ppm	< 5 ppm	< 5 ppm
Solubility EC:DMC (30:70 wt.%)	0.4 M	1 M	0.8 M	> 1 M
σ_{dc} at RT (Scm^{-1})	6.8	5.1	3.7	4.1

Figure S7 shows list of different Na^+-conductive salts and their characteristics features to be considered while preparing an electrolyte. The table provides optimal conditions for attaining water-free salts and their solubility limits in the classical electrolyte solvent mixture EC:DMC(30:70 wt.%).