Supplementary information

The impact of carbonate solvents on the self-discharge, thermal stability and performance retention of high voltage electrochemical double layer capacitors

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1 M Et_4NTFSI in BC

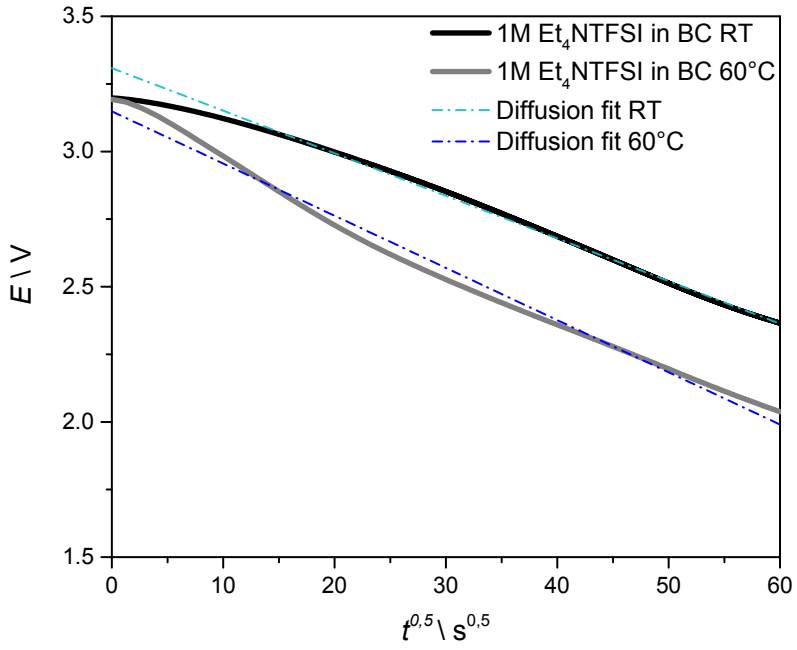

Figure SI1 Plot of the Potential for the 1M Et_4NTFSI in BC based cell vs the square root of time for the first timeframe of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Starting voltage V_0 [V]	3,2	3,2
Starting voltage V_{0F}	3,15	3,30
Diffusion parameter m [mV/sqrt(s)]	15,8	19,3

Table 1: Fit parameters of the diffusion driven self-discharge according to formula (1) for 1M Et_4NTFSI in BC.

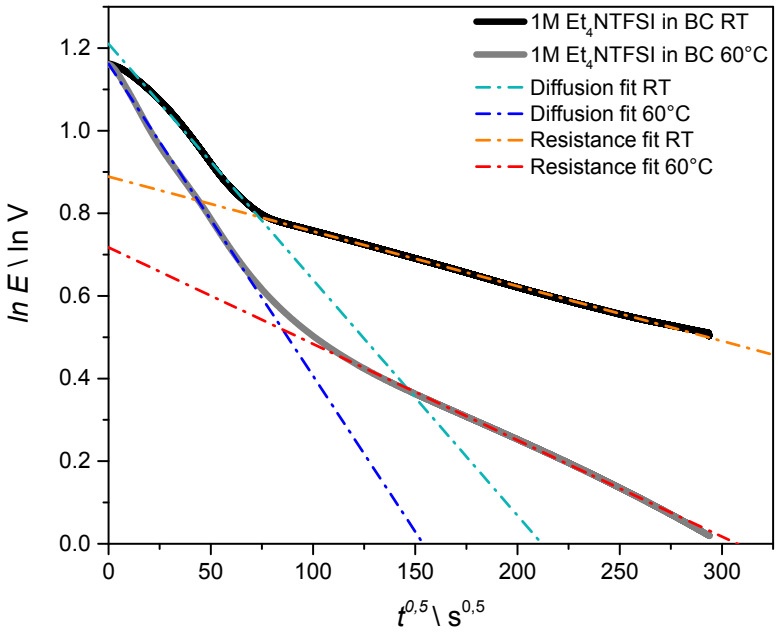

Figure SI2 Plot of the natural logarithm of the potential for the 1M Et_4NTFSI in BC based cell vs the square root of time for both time domains of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Diffusion fit intercept y-axis	1,21035	1,16172
Diffusion fit slope	-0,00571	-0,00755
Resistance fit intercept y-axis ($\ln V_0$ [ln V])	0,88889	0,71719
Resistance fit slope ($1/R_L$*C)	-0,00133	-0,00233

Table 2: Fit parameters of the diffusion driven self-discharge and the resistance limited self-discharge in logarithmic voltage with $\ln V = \ln V_0 - \left(\frac{t}{R_P \cdot C}\right)$ *for 1M Et_4NTFSI in BC.*

1 M Et_4NTFSI in PC

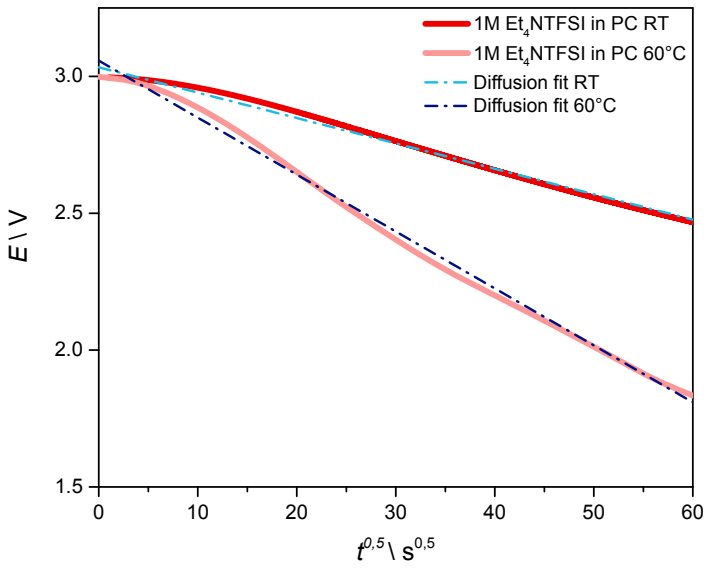

Figure SI3 Plot of the Potential for the 1M Et_4NTFSI in PC based cell vs the square root of time for the first timeframe of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Starting voltage V0 [V]	3,0	3,0
Starting voltage V_{0F}	3,03	3,06
Diffusion parameter m [mV/sqrt(s)]	9,3	20,8

Table 3: Fit parameters of the diffusion driven self-discharge according to formula (1) for 1M Et_4NTFSI in PC.

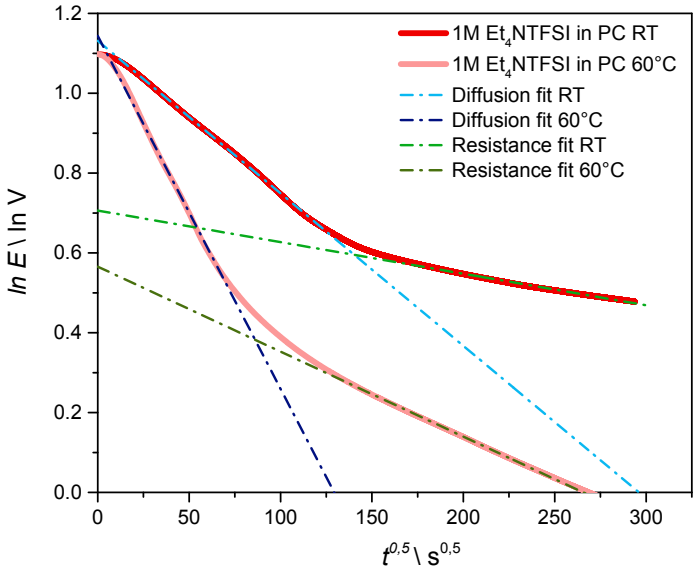

Figure SI4 Plot of the natural logarithm of the potential for the 1M Et_4NTFSI in PC based cell vs the square root of time for both time domains of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Diffusion fit intercept y-axis	1,13130	1,14360
Diffusion fit slope	-0,00382	-0,00884
Resistance fit intercept y-axis (ln V_0 [ln V])	0,70600	0,56553
Resistance fit slope ($1/R_L$*C)	-0,00079	-0,00213

Table 4: Fit parameters of the diffusion driven self-discharge and the resistance limited self-discharge in logarithmic voltage with $\ln V = \ln V_0 - \left(\frac{t}{R_P \cdot C}\right)$ *for 1M Et_4NTFSI in PC.*

1 M $Pyr_{14}TFSI$ in BC

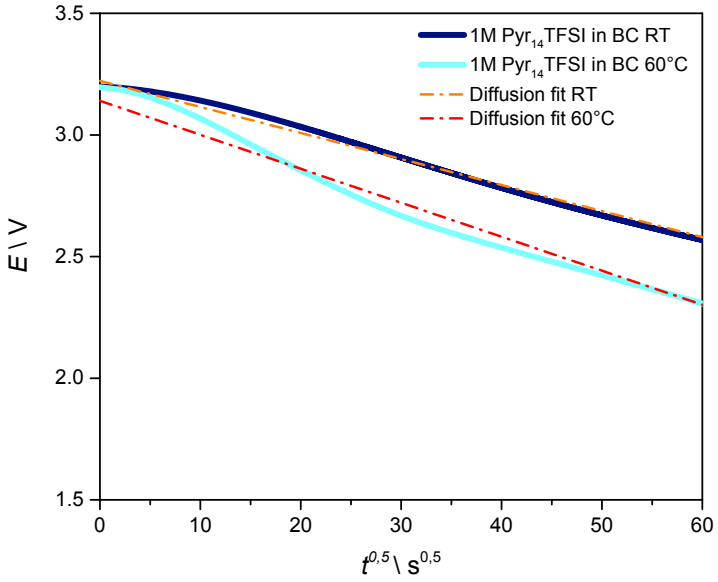

Figure SI5 Plot of the Potential for the 1M $Pyr_{14}TFSI$ in BC based cell vs the square root of time for the first timeframe of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Starting voltage V0 [V]	3,2	3,2
Starting voltage V_{0F}	3,22	3,14
Diffusion parameter m [mV/sqrt(s)]	10,7	14,0

Table 5: Fit parameters of the diffusion driven self-discharge according to formula 1M $Pyr_{14}TFSI$ in BC.

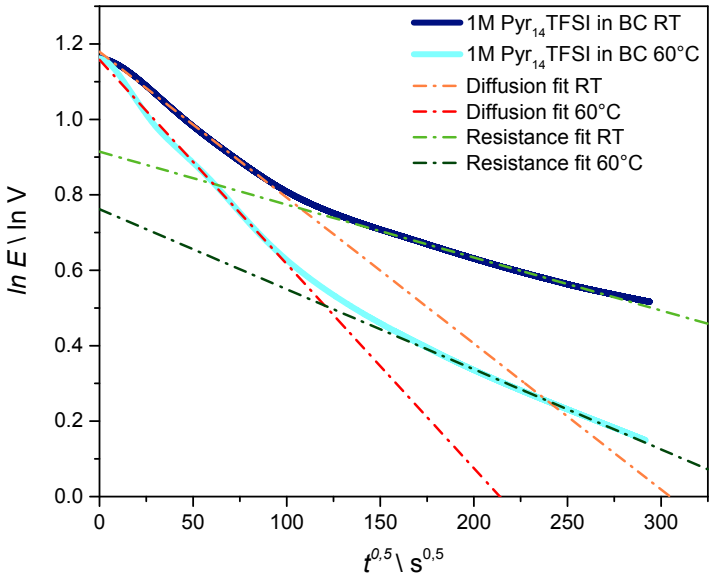

Figure SI6 Plot of the natural logarithm of the potential for the 1M $Pyr_{14}TFSI$ in BC based cell vs the square root of time for both time domains of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Diffusion fit intercept y-axis	1,17943	1,15797
Diffusion fit slope	-0,00387	-0,00541
Resistance fit intercept y-axis (ln V_0 [ln V])	0,91434	0,76188
Resistance fit slope ($1/R_L$*C)	-0,00140	-0,00212

Table 6: Fit parameters of the diffusion driven self-discharge and the resistance limited self-discharge in logarithmic voltage with $\ln V = \ln V_0 - \left(\frac{t}{R_P \cdot C}\right)$ *for 1M $Pyr_{14}TFSI$ in BC.*

1 M $Pyr_{14}TFSI$ in PC

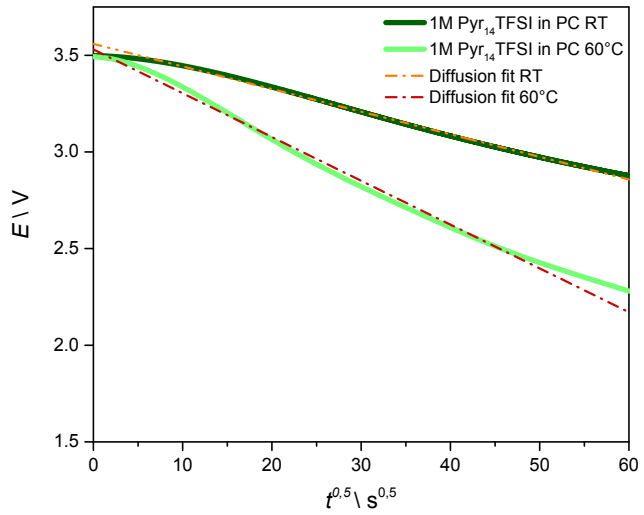

Figure SI7 Plot of the Potential for the 1M $Pyr_{14}TFSI$ in PC based cell vs the square root of time for the first timeframe of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Starting voltage V0 [V]	3,5	3,5
Starting voltage V_{0F}	3,56	3,53
Diffusion parameter m [mV/sqrt(s)]	10,7	14,0

Table 7: Fit parameters of the diffusion driven self-discharge according to formula 1 for 1M $Pyr_{14}TFSI$ in PC.

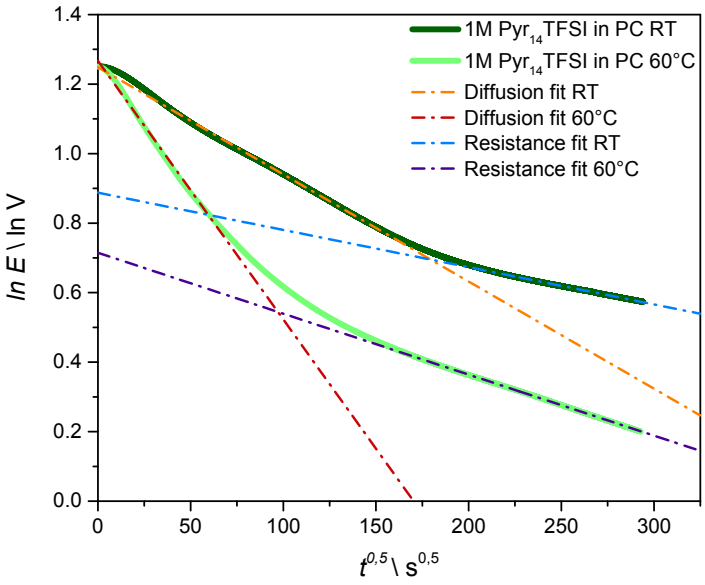

Figure SI8 Plot of the natural logarithm of the potential for the 1M Pyr_{14}TFSI in PC based cell vs the square root of time for both time domains of the discharge. The linear regressions of the discharge fits are included for room temperature and 60°C.

	RT	60°C
Diffusion fit intercept y-axis	1,17943	1,15797
Diffusion fit slope	-0,00387	-0,00541
Resistance fit intercept y-axis (ln V_0 [ln V])	0,91434	0,76188
Resistance fit slope (1/R_L*C)	-0,00140	-0,00212

Table 8: Fit parameters of the diffusion driven self-discharge and the resistance limited self-discharge in logarithmic voltage with $\ln V = \ln V_0 - \left(\frac{t}{R_P \cdot C}\right)$ *for 1M Pyr_{14}TFSI in PC.*

Calculated Parameters

Diffusion Parameters

Table 9 Calculated diffusion parameter m for all electrolytes at RT AND 60°C

Electrolyte	**Diffusion parameter (Fit 1) in mV/sqrt(s)**
Et_4NTFSI in BC (RT)	14,7
Et_4NTFSI in BC (60°C)	18,6
Et_4NTFSI in PC (RT)	9,0
Et_4NTFSI in PC (60°C)	21,0
$Pyr_{14}TFSI$ in BC (RT)	12,1
$Pyr_{14}TFSI$ in BC (60°C)	18,1
$Pyr_{14}TFSI$ in PC (RT)	12,4
$Pyr1_4TFSI$ in PC (60°C)	25,0

Resistance Parameters

Table 10 Calculated leakage resistance for all electrolytes at room temperature and at 60°C

Electrolyte	**Resistive pathway fit slope**	**Capacitance [F]**	**Resistance [kOhm]**
Et_4NTFSI in BC (RT)	-0,00107	0,0117	80
Et_4NTFSI in BC (60°C)	-0,00175	0,0117	49
Et_4NTFSI in PC (RT)	-0,00079	0,0129	98
Et_4NTFSI in PC (60°C)	-0,00213	0,0129	36
$Pyr_{14}TFSI$ in BC (RT)	-0,00140	0,0133	54
$Pyr_{14}TFSI$ in BC (60°C)	-0,00212	0,0133	35
$Pyr_{14}TFSI$ in PC (RT)	-0,00133	0,0117	64
$Pyr1_4TFSI$ in PC (60°C)	-0,00175	0,0117	49