

Supporting Information

Carbon Black/Electrolyte Interface study by Electromagnetic and Electrochemical Techniques in $\gamma\text{Al}_2\text{O}_3$ /Poly(vinylidene fluoride)/Carbon Black Composite Materials: Application for Lithium-Ion Batteries

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S1. Comparison of permittivities of dry and soaked samples with carbon black CB1

The carbon black powder denoted CB1 was supplied by Alfa Aesar with a specific surface area of about $80 \text{ m}^2 \cdot \text{g}^{-1}$.

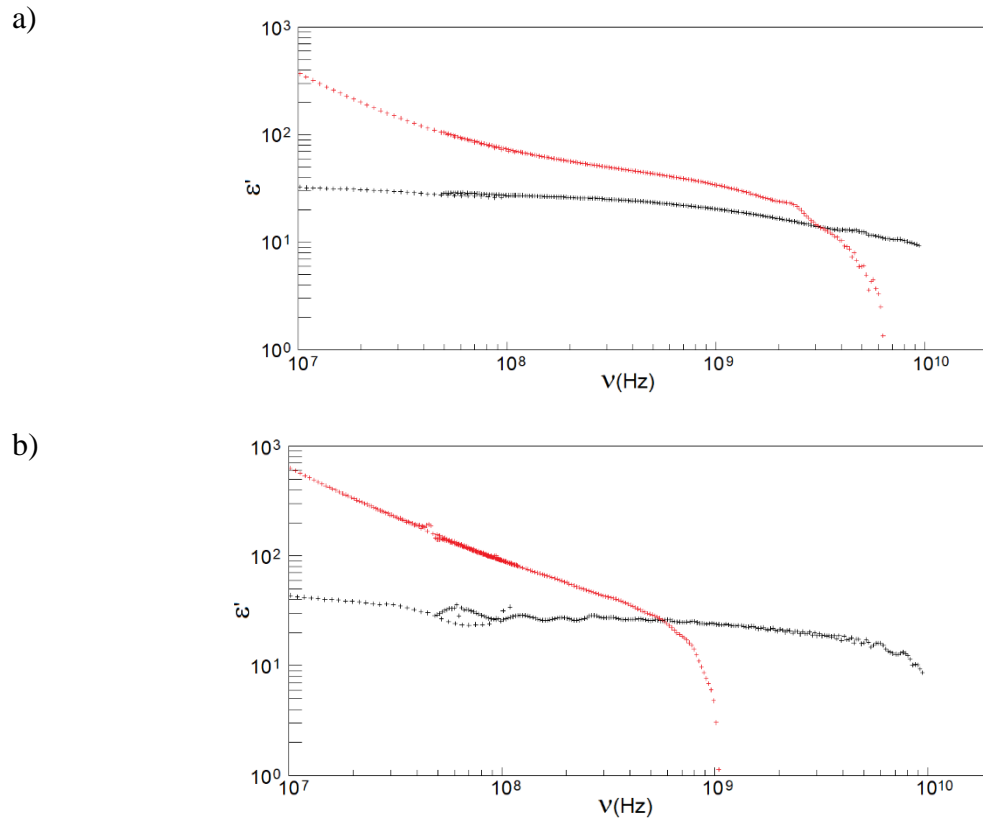


Figure S1. Frequency dependent real part of permittivity ϵ' at 293 K for dry (+++) and soaked (+++) samples with the following CB1 volume fractions: a) $\phi_{\text{CB}} = 5.3 \%$ and b) $\phi_{\text{CB}} = 7.8 \%$.

S2. Comparison between Electrochemical Impedance Spectroscopy (EIS) and Broadband Dielectric Spectroscopy (BDS)

The carbon black (CB1) mass M_{CB} is:

$$M_{CB} = M \times C_M \quad (S1)$$

where M is the sample (pellet) mass and C_M the mass fraction of CB1. The carbon black (CB1) total surface is:

$$S_{CB} = S_{sp} \times M_{CB} \quad (S2)$$

where $S_{sp} = 80 \text{ m}^2 \cdot \text{g}^{-1}$ is the specific surface of CB1. The resistivity $\rho_{50\text{kHz}}$ measured at 50 kHz by EIS is given by

$$\rho_{50\text{kHz}} = \rho'_{50\text{kHz}} - i\rho''_{50\text{kHz}} = \frac{\pi r_p^2}{L S_{CB}} (Z'_{50\text{kHz}} - iZ''_{50\text{kHz}}) \text{ (in } \Omega \cdot \text{m)} \quad (S3)$$

where $Z'_{50\text{kHz}}$ (in $\Omega \cdot \text{m}^2$) is the real part of impedance at 50 kHz, L the sample thickness and $S = \pi r_p^2$ the geometric surface of the sample with radius $r_p = 3.5 \text{ mm}$. The real part of the complex conductivity is

$$\sigma'_{50\text{kHz}} = \frac{\rho'_{50\text{kHz}}}{(\rho'^2_{50\text{kHz}} + \rho''^2_{50\text{kHz}})} \text{ (in } \text{S} \cdot \text{m}^{-1}) \quad (S4)$$

Since there is no overlap between EIS and BDS measurements, conductivity values at the highest frequency 50 kHz ($\sigma'_{50\text{kHz}}$) and the lowest frequency 1 mHz ($\sigma'_{1\text{mHz}}$) of EIS are compared in Table S1.

Table S1. Parameters (sample mass and thickness, CB1 mass and surface) for determining the real part of the conductivity at 50 kHz vs. the CB1 fraction

CB1 % Mass Volume	Sample mass M (mg) Sample surface L (mm)	CB1 mass M_{CB} (mg) CB1 surface S_{CB} (m^2)	$Z'_{50\text{kHz}}$ $Z''_{50\text{kHz}}$ ($\Omega \cdot \text{m}^2$)	$Z'_{1\text{mHz}}$ $Z''_{1\text{mHz}}$ ($\Omega \cdot \text{m}^2$)	$\sigma'_{50\text{kHz}}$ ($\text{S} \cdot \text{m}^{-1}$)	$\sigma'_{1\text{mHz}}$ ($\text{S} \cdot \text{m}^{-1}$)
8.0	51	4.08	15	195	0.5	0.07
5.3	0.89	0.33	5	105		
10.0	54	5.40	20	225	0.4	0.03
6.9	0.88	0.43	8	115		
12.5	53	6.6	8	185	1.0	0.06
7.8	0.96	0.53	7	100		
15.0	59	8.9	12	195	1.5	0.08
9.2	1.04	0.71	4	105		