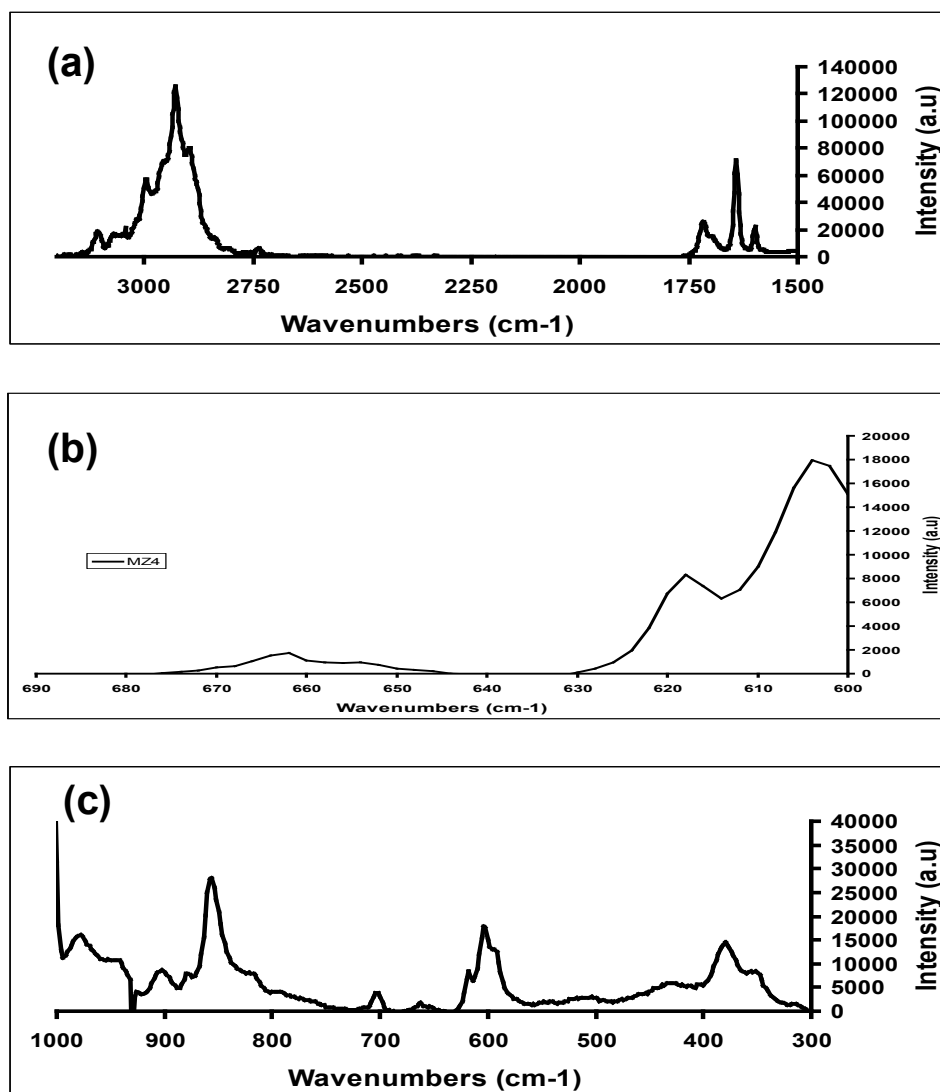
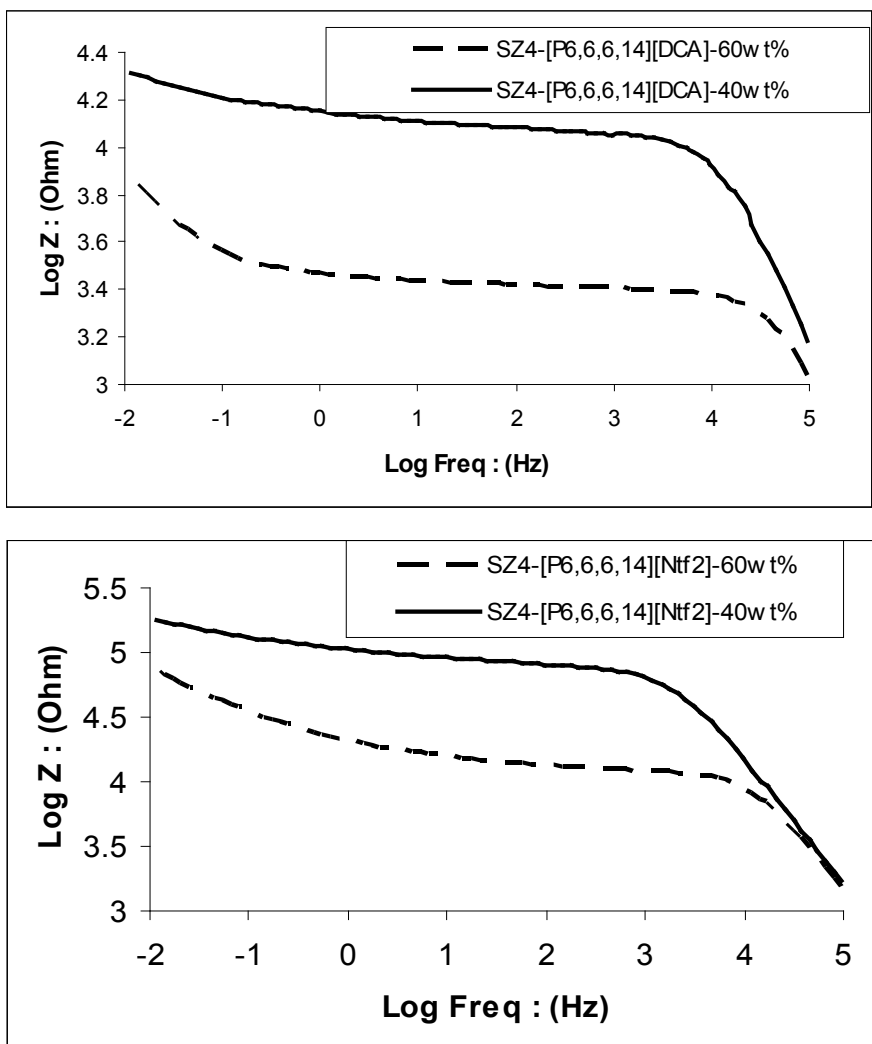


## Supplementary Information

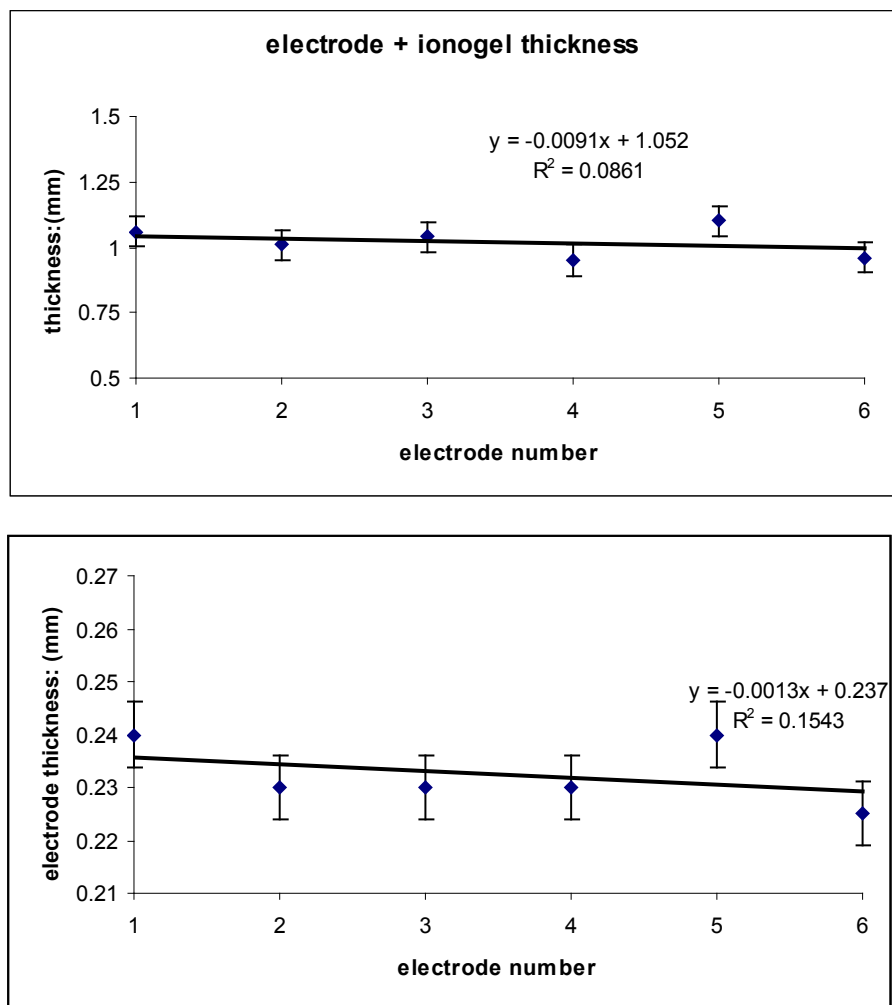


**Figure S1:** Raman Spectrum obtained for hybrid material SZ4; (a) 3200cm<sup>-1</sup> – 1500cm<sup>-1</sup>, (b) 600cm<sup>-1</sup> – 690cm<sup>-1</sup> and (c) 1000cm<sup>-1</sup> – 300cm<sup>-1</sup>.



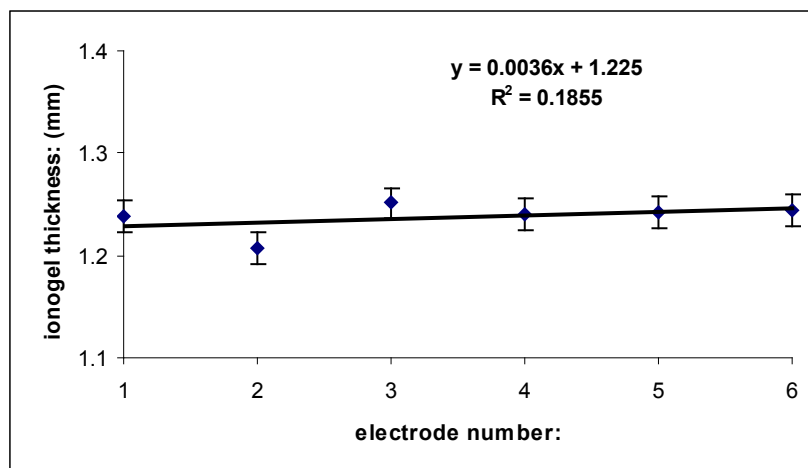
**Figure S2:** Bode plots obtained for increasing concentrations of [P<sub>6,6,6,14</sub>][DCA] and [P<sub>6,6,6,14</sub>][NTf<sub>2</sub>] incorporated in SZ4 matrix.

**Figure S3: Ionogel Thickness Analysis**



|                | <i>electrode thickness</i> |          | <i>electrode + ionogel</i> |                                |
|----------------|----------------------------|----------|----------------------------|--------------------------------|
|                | mm                         |          | mm                         |                                |
| <b>1</b>       | 0.24                       | <b>1</b> | 1.06                       |                                |
| <b>2</b>       | 0.23                       | <b>2</b> | 1.01                       |                                |
| <b>3</b>       | 0.23                       | <b>3</b> | 1.04                       |                                |
| <b>4</b>       | 0.23                       | <b>4</b> | 0.95                       |                                |
| <b>5</b>       | 0.24                       | <b>5</b> | 1.1                        | <i>ionogel thickness: (mm)</i> |
| <b>6</b>       | 0.225                      | <b>6</b> | 0.96                       |                                |
| <b>average</b> | 0.2325                     |          | 1.02                       | 0.7875                         |
| <b>stdev</b>   | 0.006123724                |          | 0.058309519                |                                |

**Figure S3(a):** Ionogel and electrode thickness reproducibility analysis for ionogels containing 60wt% phosphonium IL and 40wt% SZ4.



**electrode + ionogel**

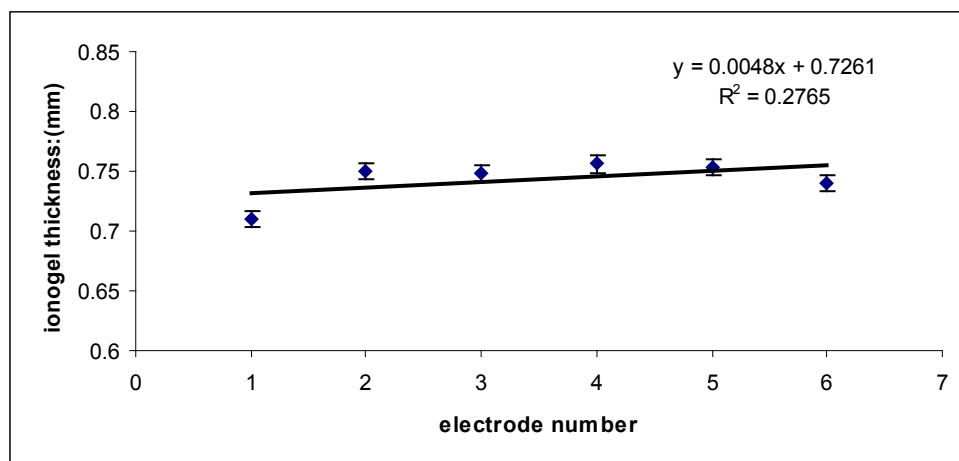
|          | mm    |
|----------|-------|
| <b>1</b> | 1.239 |
| <b>2</b> | 1.207 |
| <b>3</b> | 1.251 |
| <b>4</b> | 1.241 |
| <b>5</b> | 1.242 |
| <b>6</b> | 1.245 |

**average**  
**stdev**

1.2375  
0.015515

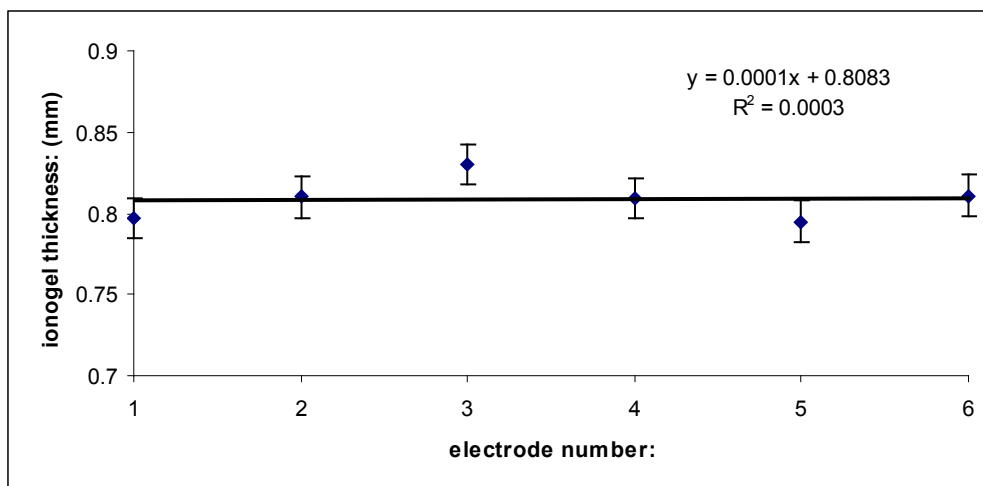
**ionogel thickness: (mm)**  
1.0035

**Figure S3 (b):** Ionogel reproducibility analysis for ionogels containing 40wt% phosphonium IL and 60wt% SZ4.



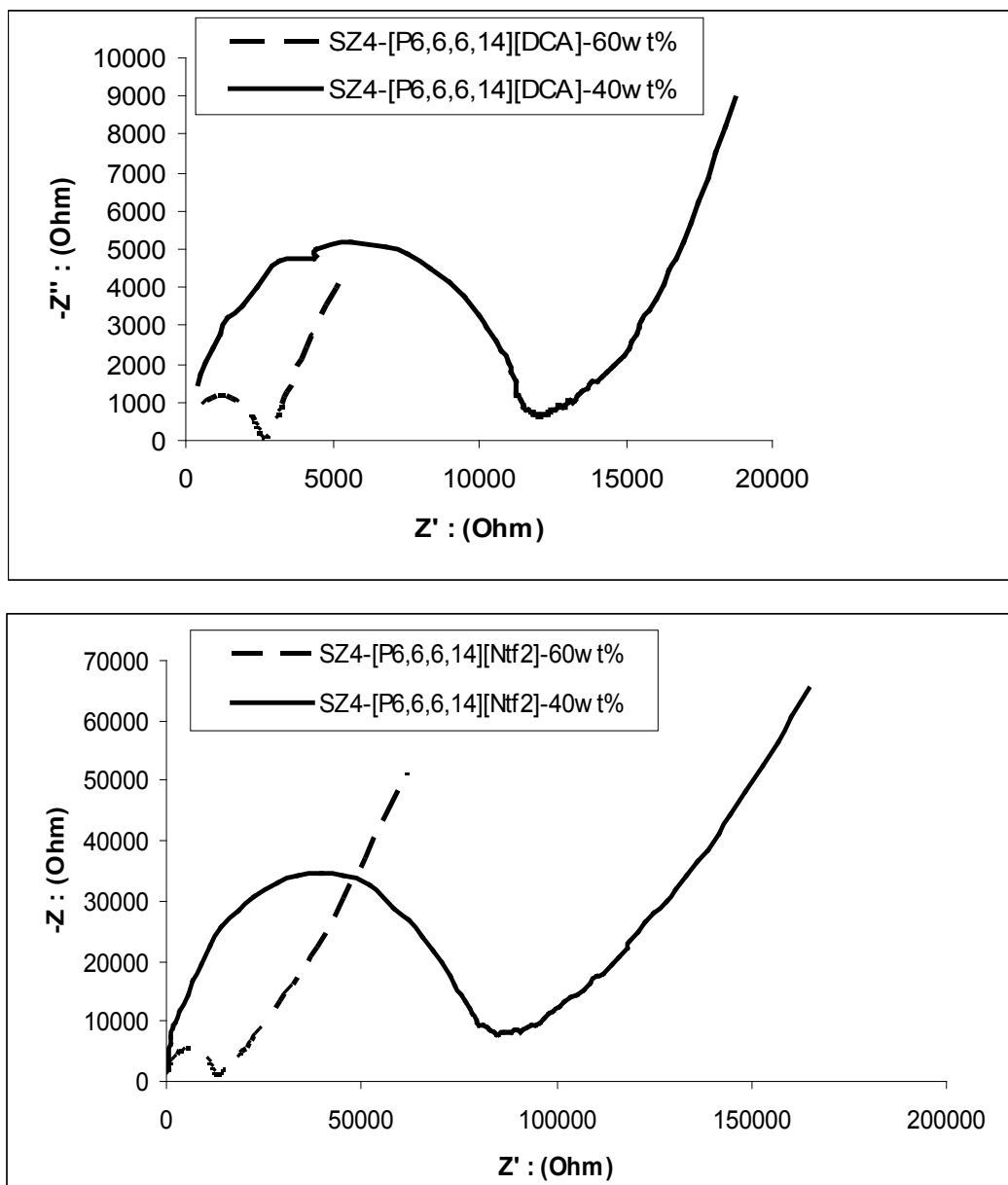
| <i>electrode + ionogel</i> |          |                                |
|----------------------------|----------|--------------------------------|
|                            | mm       |                                |
| <b>1</b>                   | 0.71     |                                |
| <b>2</b>                   | 0.75     |                                |
| <b>3</b>                   | 0.748    |                                |
| <b>4</b>                   | 0.756    |                                |
| <b>5</b>                   | 0.753    |                                |
| <b>6</b>                   | 0.74     |                                |
| <b>average</b>             | 0.74925  | <i>ionogel thickness: (mm)</i> |
| <b>stdev</b>               | 0.006994 | 0.59925                        |
|                            | 0.699405 |                                |

**Figure S3 (c):** Ionogel thickness reproducibility analysis for ionogels containing 50wt% [emIm][FAP] and 50wt% SZ4.



| <i>electrode + ionogel</i> |          |                                |
|----------------------------|----------|--------------------------------|
| mm                         |          |                                |
| <b>1</b>                   | 0.797    |                                |
| <b>2</b>                   | 0.81     |                                |
| <b>3</b>                   | 0.83     |                                |
| <b>4</b>                   | 0.809    |                                |
| <b>5</b>                   | 0.795    |                                |
| <b>6</b>                   | 0.811    |                                |
| <b>average</b>             | 0.808667 | <i>ionogel thickness: (mm)</i> |
| <b>stdev</b>               | 0.012533 | 0.658666667                    |

**Figure S3 (d):** Ionogel thickness reproducibility analysis for ionogels containing 80wt% [emIm][FAP] and 20wt% SZ4.



**Figure S4:** Nyquist plots obtained for (a) SZ-4 ionogels containing 60 wt% of  $[P_{6,6,6,14}][DCA]$  and (b)  $[P_{6,6,6,14}][NTf_2]$ .