Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary

Uncertainties and Error Bars:

The density, viscosity and conductivity of each composition were measured three times. Error bars shown represent less than 0.05 standard deviation across the three measurements for each experiment.

Walden Plot of tetraglyme/zinc chloride mixtures (mole ratios) ranging from 25 ˚C – 90 ˚C.

The Walden plot is widely used in the ionic liquid field to illustrate the relationship between the molar conductivity (Λ) and the fluidity ($1/\eta$) of the ions. A number of authors [20-22] have discussed the degree of ion dissociation, also described as ionicity, in ionic liquids using the relationship between log (Λ) and log (η-1) that is expressed in the Walden plot. Generally in a Walden plot, the data is compared to the behaviour of an ideal reference material (aqueous KCl data) where the ions are completely dissociated. However in the present case which involves a divalent cation, the KCl reference point is not relevant and therefore we simply use the plot as a means of assessing the trends in these zinc based compositions.

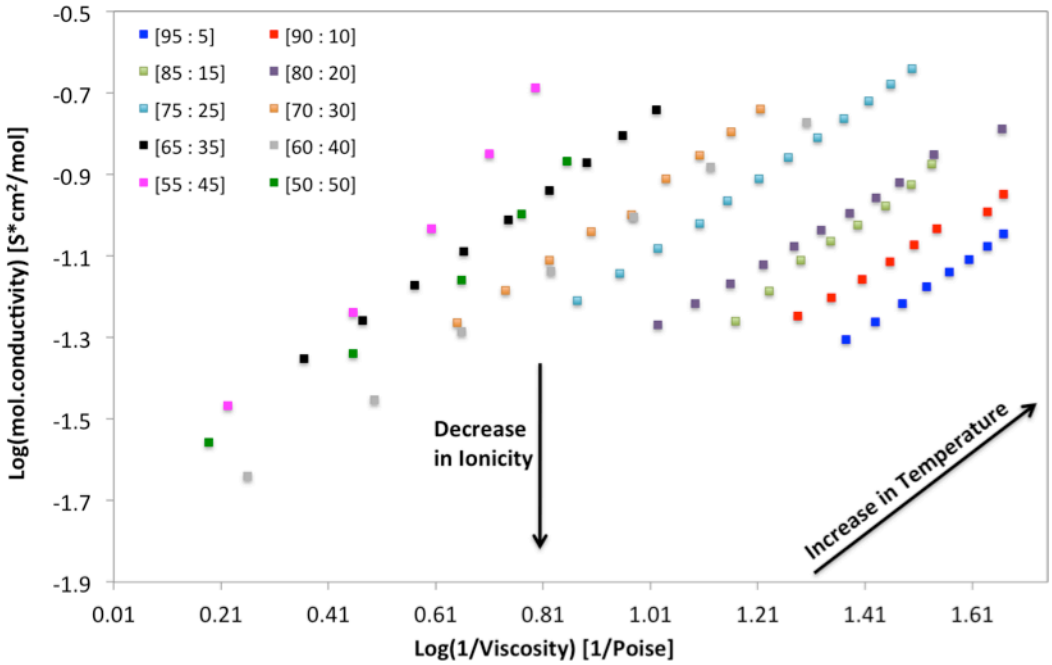


Figure S1.1 Walden Plot of tetraglyme/zinc chloride mixtures (mole ratios) ranging from 25 ˚C – 90 ˚C.

DSC traces of the molar ratios of tetraglyme to zinc chloride ranging from -125 ˚C – 100 ˚C.

All samples were measured at the rate of 10˚C/min and the data below shows the DSC trace of the third cycle.

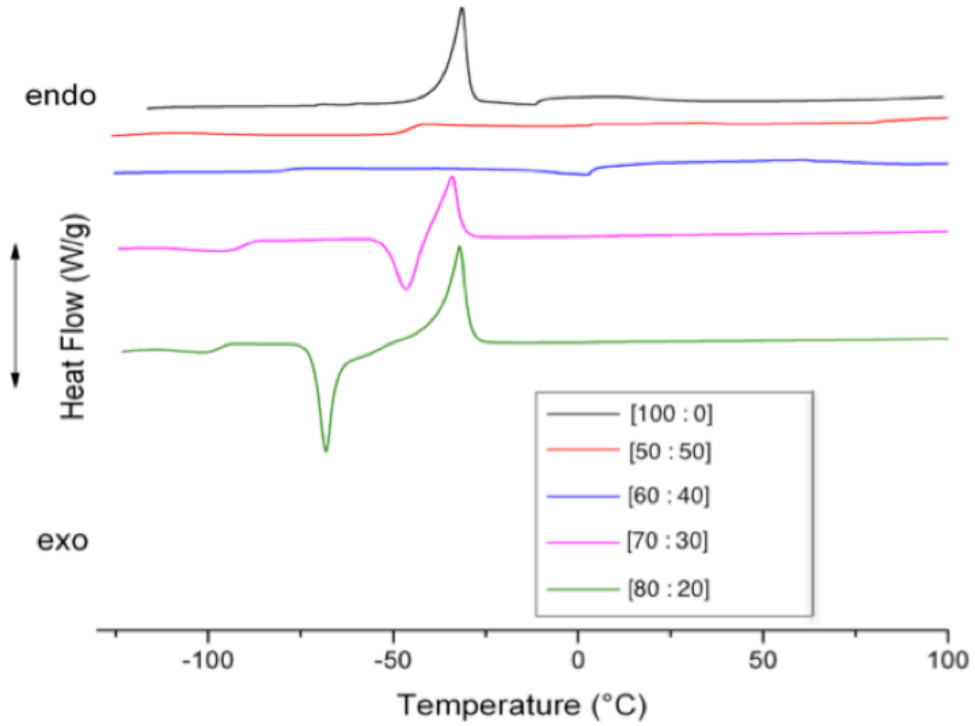


Figure S2.1: DSC traces of the molar ratios of tetraglyme to zinc chloride ranging from -125 ˚C – 100 ˚C.

Raman spectroscopy In the range: 750cm^{-1}–1350cm^{-1}.

Note: the CH_2 rocking peak between 800-900 cm^{-1} was used as the basis for normalisation since this was the peak that changed the least with varying concentration of zinc.

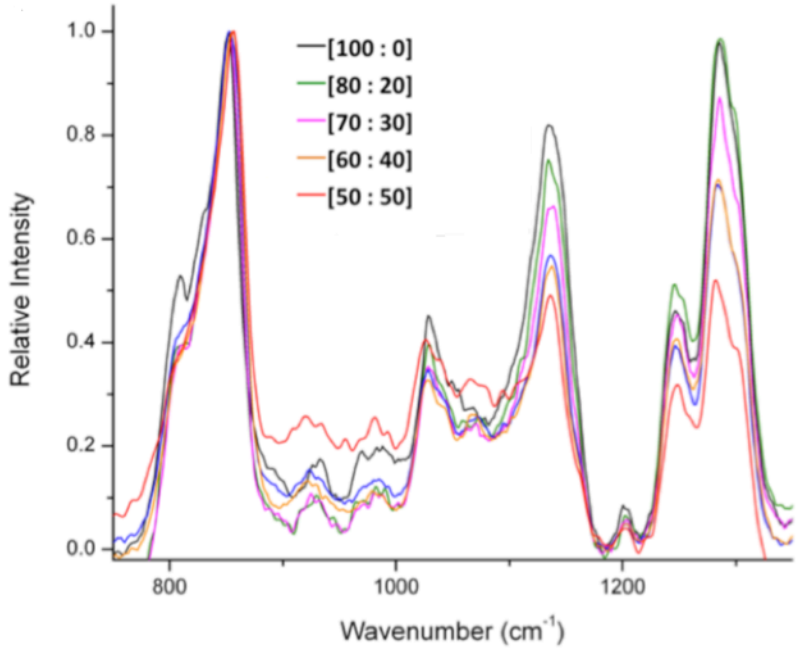


Figure S3.1: Raman spectroscopy in the range: 750cm^{-1}–1350cm^{-1}.

Raman spectroscopy in the range: 800-900 cm^{-1}.

Note: A peak between 165-175 cm^{-1} was used as the basis for normalisation since this was the peak that changed the least with varying concentration of zinc chloride.

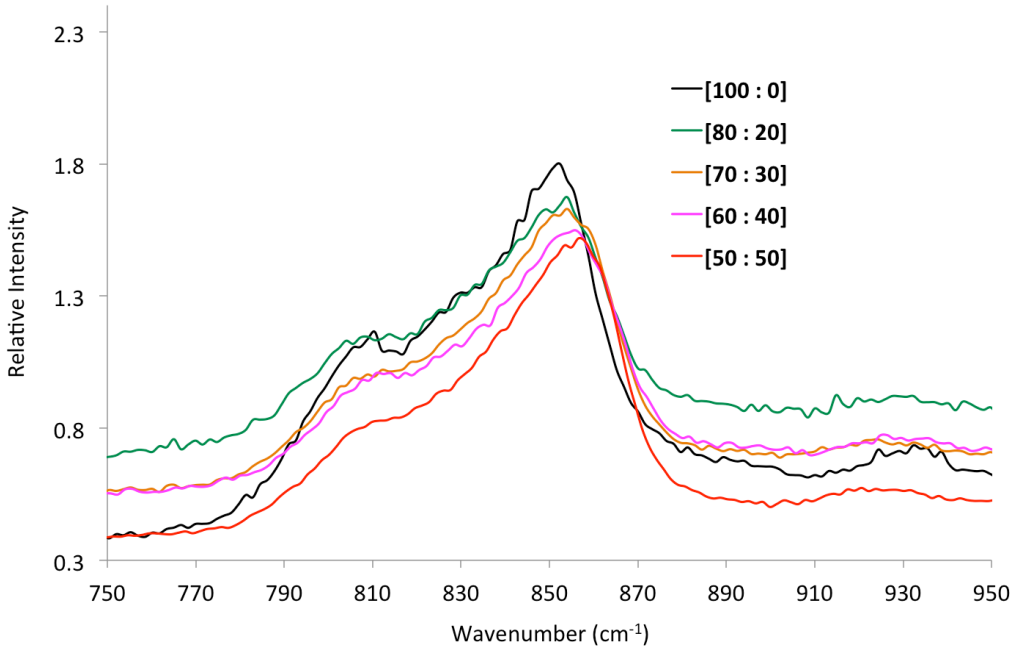
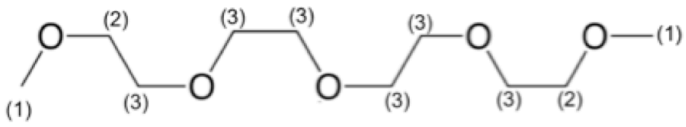


Figure S3.2: Raman spectroscopy in the range: 800-900 cm^{-1}.

Scheme 2: Structure and ^{13}C NMR numbering scheme of tetraglyme.



(1) $-CH_3$

(2) *t*-$[CH_2CH_2]$

(3) *m*-$[CH_2CH_2]$

^{13}C NMR Spectrum of the molar ratios of tetraglyme to zinc chloride.

d-DMSO was added in a external NMR tube and used as a reference point. All NMR data were normalised to the DMSO peak observed approximately around 39.1-41.5 ppm.

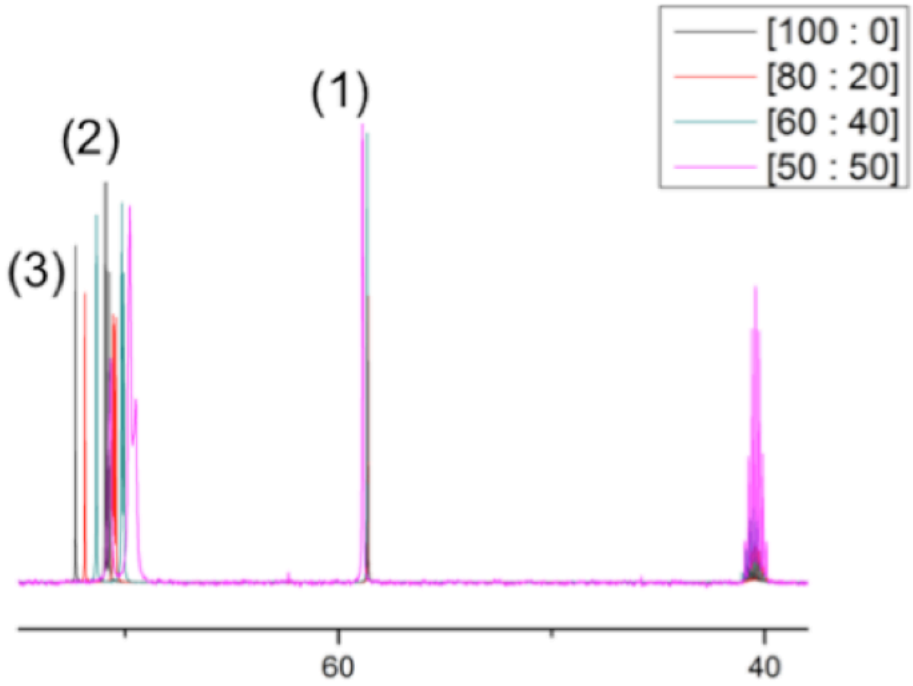


Figure S4.1: ^{13}C NMR Spectrum of the molar ratios of tetraglyme to zinc chloride.

Cyclic voltammetry of the [70 : 30] composition at 25 ˚C over 30 cycles.

All samples were degassed for 15 minutes and the experiments were conducted under Nitrogen (N_2) gas.

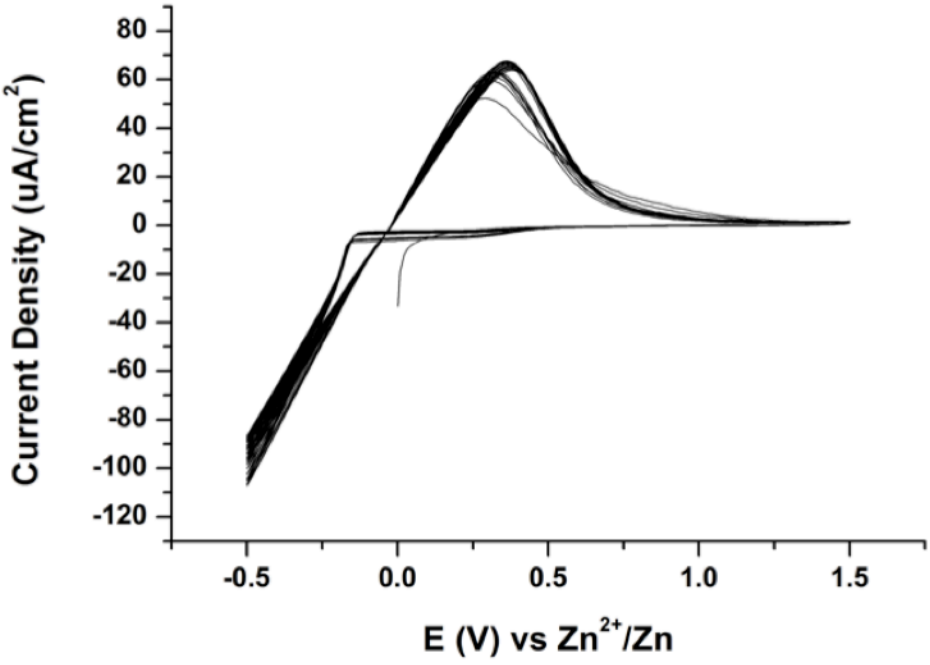


Figure S5.1 Cyclic voltammetry of the [70 : 30] composition at 25 ˚C over 30 cycles.