Ionic Liquids - Inherent Sensing and Transduction of Metal Ion complexation

Andrew Kavanagh[*a], Matthius Hilder[b], Noel Clark[b], Dermot Diamond[*a] and Aleksandar Radu[*a]*

[a] *CLARITY, The Centre for Sensor Web Technologies, National Centre for Sensor Research, School of Chemical Sciences, Dublin City Univeristy, Glasnevin, Dublin 9, Ireland.*
[b] *CSIRO Materials Science and Engineering, Bayview Avenue, Clayton, Melbourne, Australia.*

Email: Andrew.kavanagh@dcu.ie, Dermot.diamond@dcu.ie, aleksandar.radu@dcu.ie

Ionic Liquids (IL's) – organic salts that are liquid at room temperature, have many favourable characteristics. Their inherent conductivity and wide available electrochemical window has led to their use in electrochemical sensing techniques[1]. Radio frequency (RF) detection provides a technique which can monitor conductivity wirelessly, but also has the required sensitivity and is non-invasive on the sample. We have used the IL *trihexyltetradecylphosphonium dicyanamide,* which can easily be incorporated and solidified into a polymeric membrane.
The resulting membrane displays an optical response upon complexation with metal ions such as Cu^{2+} (yellow), Co^{2+} (blue) and both ions simultaneously (green).
RF can not only discriminate between the coordinated and noncoordinated membranes, but also between the individual coloured membranes. The resultant downward trend in conductivity has been validated by Electrochemical Impedance Spectroscopy (EIS) and by portable X-Ray Flourescence (XRF).
XRF compliments results obtained from RF and EIS are directly related to the binding selectivity of the IL, which shows higher binding preference for Cu^{2+} over Co^{2+}, thereby, producing the lowest conductivity signal.
IL's have been shown to bind to a variety of heavy metal ions, plus important target analytes such as CO_2.[2] If a drop in conductivity can be presumed upon binding to the analyte, then the inherent conductivity of IL's can be exploited in future electrochemical sensing.

[1]. D. Wei., *Anal. Chim. Acta.* 2008, **607**, 126-135
[2]. E. Bates., *J. Am. Chem. Soc.,* 2002, **124**, 926-927