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Ionic Liquids Symposium

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In early 2003 a small group of people from Monash University and CSIRO suggested that a local workshop and symposium on ionic liquids be run, to draw together the numerous and quite diverse groups in the Melbourne area working on, or using, ionic liquids. Around 25 people were expected to attend. The intention was to provide both a workshop format for researchers new to the field and wanting to learn and discuss more about these materials, as well as a symposium-style event where up to the minute research results could be presented. The symposium took place at CSIRO Molecular Science in late May 2003 with around 65 people attending and contributing, turning the symposium into a broad ranging and very stimulating event.

This level of intense interest has been a feature of a number of ionic liquids (IL) meetings around the world in the last few years. Ionic liquids appear to offer an immense range of potential liquid- and solution-state properties that have not been possible, or at least difficult, to achieve in conventional solvents. Thus they are of interest in a wide range of applications. This diversity of properties and applications is expressed in the papers presented, a selected subset of which are presented in this issue of the *Australian Journal of Chemistry*—from drug synthesis to electrosynthesis, from batteries to polymerization chemistry.

Ken Seddon from the Queens University Ionic Liquids Laboratory (QUILL) was the plenary speaker and led off the workshop with an introduction to ILs. Stewart Forsyth then provided an overview (reproduced in this issue[1]) of ILs and their applications, from the perspective of the chemistry of the cations and anions. The variation in properties that can be wrought from the range of anions that have been studied is typically, thus far, much greater than can be obtained from the cation. Nonetheless the cation has become the focus of more attention recently, in particular as the source of chirality in the IL.

The paper by Forsyth et al.[2] on the tricyanomethanide (TCM) compounds exemplifies an new range of ILs generated by combination of this novel (from the IL perspective) anion with a traditional range of cations. As expected from the almost-flat geometry of the anion, the viscosity is particularly low for ILs based on this anion when combined with the equally (almost) planar geometry of the ethylmethylimidazolium (emIm) cation. The viscosity of [emIm][TCM] is among the lowest ever observed and, correspondingly, the ion conductivity among the highest observed. The latter is particularly important in electrochemical applications.

A significant fraction of the papers presented in the symposium related to synthetic applications of ILs as novel solvents, which either simply offer improved solvent properties in various ways or additionally offer chemical advantages, such as improved rate and yield. The paper by Hemeon et al.[3] describes the use of ILs in MnO_2-promoted allylic and benzylic oxidation reactions; the extraction of the products and all important subsequent recycling on the IL are also examined. Vijayaraghavan and MacFarlane[4] in their paper on charge-transfer polymerization of methyl methacrylate show enhanced rate and yield when the reaction is carried out in an ionic liquid; they suggest that this may originate from the stabilization by the IL of the charged species that are generated during this polymerization reaction. The paper by Bowyer et al.[5] examines similar rate issues in a novel route to α-allyl-β-hydroxy carboxylic acids and shows that the reaction is facile in [bmIm][BF_4].

Returning to the investigation of whole new families of compounds, Yoshigawa and Ohno[6] describe zwitterionic compounds that are structural relatives of the imidazolium cation and sulphonate anions. These compounds should exhibit many of the interesting properties of their ionic relatives but are not ionically conductive. This feature is

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of interest in some electrochemical applications, for example batteries, where the general IL properties are extremely valuable but the background ion conductivity is not.

Also expressed in the symposium, by way of its absence, is a detailed database of physical property information of the sort that exists for conventional solvents. The number of ILs is growing rapidly year-by-year, however the physical property measurement effort lags further and further behind because of the sheer enormity of the task. Efforts in this direction are reported by Baranyai et al.[7] who describe detailed measurements of the high-temperature breakdown limits of ILs, reporting that for long-term use at high temperatures the upper limits may be lower than first thought. Earle et al.[8] describe an investigation of the polarity of ILs, using a novel approach based on the keto–enol tautomerization reaction; they report that IL polarities may be higher than previous measurements based on other methods have indicated.

Nonetheless, a very large database of information remains to be generated. Of particular urgency is information regarding toxicity of these materials;[9] this information is beginning to appear as described in Forsyth's overview; but much more is needed, as is property information generally. It is our hope that collections of papers such as these which express the range of applications possible for ionic liquids will stimulate the interest of those with the skills and equipment in the physical property measurement area to tackle this task.

References

[1] S. A. Forsyth, J. M. Pringle, D. R. MacFarlane, *Aust. J. Chem.* **2004**, *57*, 113. doi:10.1071/CH03231

[2] S. A. Forsyth, S. R. Batten, Q. Dai, D. R. MacFarlane, *Aust. J. Chem.* **2004**, *57*, 121. doi:10.1071/CH03245

[3] I. Hemeon, N. W. Barnett, N. Gathergood, P. J. Scammells, R. D. Singer, *Aust. J. Chem.* **2004**, *57*, 125. doi:10.1071/CH03246

[4] R. Vijayaraghavan, D. R. MacFarlane, *Aust. J. Chem.* **2004**, *57*, 129. doi:10.1071/CH03236

[5] M. C. Bowyer, C. M. Gordon, S. K. Leitch, A. McCluskey, C. Ritchie, *Aust. J. Chem.* **2004**, *57*, 135. doi:10.1071/CH03212

[6] M. Yoshizawa, A. Narita, H. Ohno, *Aust. J. Chem.* **2004**, *57*, 139. doi:10.1071/CH03240

[7] K. J. Baranyai, G. B. Deacon, D. R. MacFarlane, J. M. Pringle, J. L. Scott, *Aust. J. Chem.* **2004**, *57*, 145. doi:10.1071/CH03221

[8] M. J. Earle, B. S. Engel, K. R. Seddon, *Aust. J. Chem.* **2004**, *57*, 149. doi:10.1071/CH03259

[9] N. Gathergood, P. J. Scammels, *Aust. J. Chem.* **2002**, *55*, 557. doi:10.1071/CH02159