

Kenneth R. Seddon – A Rock Star of Ionic Liquids

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At the beginning of 2018, the world of science lost one of its most unique and influential people. Professor Kenneth R. Seddon was a pioneering chemist, who dedicated his life to the study and promotion of ionic liquids as a broad chemical platform.

Ken started his life journey on 31 August 1950 in Liverpool, where he also graduated and undertook his Ph.D. studies. After that, he moved to Oxford, where he worked for almost a decade at St Catherine's College. In 1982, he became Reader in Experimental Chemistry at Sussex University, and it was during this time that he noticed the remarkable properties of ionic liquids. His first funding to investigate these materials further was obtained from the BP Venture Fund in 1988. The work was initially carried out at Sussex and, from 1993, continued at Queen's University Belfast, where Ken became Professor of Inorganic Chemistry. In 1998, he established the Queen's University Ionic Liquid Laboratories (QUILL), the first research centre fully committed to the study of ionic liquids. It became a broad-based team of scientists who, under Ken's lead, pursued the development and application of ionic liquids in collaboration with a wide range of companies, including Petronas, Shell, and Chevron.

During this period that spanned three decades, Ken worked on a wide variety of ionic liquid topics, from synthesis and

characterisation, to properties and industrial applications. Significant work included an understanding of the unexpected distillation and volatility of ionic liquids, as published in *Nature* in 2006 with M. J. Earle and others,^[1] where it was shown that many ionic liquids can be distilled at very low pressure without decomposition. He also led an approach to systematically defining ionic liquids according to their polarity, using this familiar terminology to entice other scientists towards their use as replacements for common solvents. Particularly significant was Ken's demonstration of the use of ionic liquids as synthetic solvents and catalysts; for example, in Diels-Alder reactions to improve rate and selectivity. All of his work was pioneering in its time and helped to build pathways by which the ionic liquid field could develop towards new and more significant applications.

Ken was an outstanding scientist; during his career he published around 400 articles, 50 patents, and several books. His achievements were appreciated well beyond the research community, his honours including the Order of the British Empire (OBE) in 2015. Ken's achievements also included translation of his science to large-scale industrial applications. In 2012, developments by the QUILL team led to implementation of a new



Dr Karolina Matuszek received her Ph.D. degree from the Silesian University of Technology in Gliwice, Poland, in 2017. During this time, she collaborated with Professor Seddon and Dr Swadźba-Kwaśny. Currently Karolina is a Research Fellow at Monash University (Melbourne, Australia) supervised by Professor Douglas MacFarlane. Karolina's research is focused on the synthesis and application of ionic liquids as catalysts and phase change materials.



Dr Mega Kar completed her undergraduate degree with honours at The University of Melbourne in 2008. She then went on to study for her doctor of philosophy (Ph.D.) degree at Monash University (2012–2015). Dr Kar is currently a Laureate Research Fellow at Monash University, lecturing and specialising in IL synthesis and electrochemistry and working on electrodeposition and metal batteries. Along with Professor Douglas MacFarlane and Associate Professor Jennifer Pringle, she has co-authored a textbook titled 'Fundamentals of Ionic Liquid Science – From Chemistry to Applications', published in 2017.



Professor Doug MacFarlane is an Australian Laureate Fellow and leader of the Energy Program in the Australian Centre for Electromaterials Science. He is one of the pioneers of the field of ionic liquids and his group, along with collaborators in Australia and worldwide, has published more than 650 papers and 30 patents. Professor MacFarlane was a B.Sc.(Hons) graduate of Victoria University Wellington and obtained his Ph.D. degree from Purdue University. He was appointed Professor of Chemistry at Monash University in 1995. He was elected to the Australian Academy of Science in 2007 and was awarded the Academy's Craig Medal for achievement in chemistry in 2018. He was elected to the Australian Academy of Technological Sciences and Engineering in 2009. He is an International Fellow of the Queen's University Belfast and a Visiting Professor of the Chinese Academy of Sciences.

technology for mercury removal from natural gas using ionic liquids (the Hycapure HgTM process). This development earned QUILL several significant awards, including the Institute of Chemical Engineering's Teamwork in Innovation Award and the Niklin Medal.

Among his many endeavours, Ken was a strong supporter of the *Australian Journal of Chemistry*, serving as an active and passionate Associate Editor of the Journal for nearly 10 years (2008–2018) – the only such editorial position he held as far as we know – establishing in the process a special attachment to Australia and our chemistry community.

With this special edition of *Aust. J. Chem.*, published for the first anniversary of Ken's passing, the ionic liquids community honours his contributions and leadership of the field. The issue reports on studies of a variety ionic liquid topics including a perspective article entitled 'Ionic Liquids — Further Progress on the Fundamental Issues'^[2] highlighting some of the issues that continue to challenge the field. The article is in-part based on ideas and discussions that Ken was part of before his illness and reprises the themes of an article that he coauthored in *Aust. J. Chem.* 10 years ago.

Several of the articles in this special issue focus on the unique properties of ionic liquids, including papers from the well known groups of Ohno, Chiappe, Hardacre, and Yoshizawa-Fujita. Ohno and co-workers investigate fluctuations and mixing states of aqueous solutions of ionic liquids, and show the relationship between these fluctuations and phase transitions.^[3] Chiappe and co-workers discuss the promising topic of ionic liquid mixtures,^[4] while Hardacre and his team report on a thermal conductivity enhancement caused by the dispersion of nanoparticles in ionic liquids.^[5] Yoshizawa-Fujita and the group at Sophia University demonstrate relationships between physicochemical properties and chemical structure in protic ionic liquids.^[6] A recent paper in *Aust. J. Chem.* (issue 7, 2018) on the effect of ionic liquids on *Artemia salina* by Yoshimura and Shimizu also makes an important contribution to the understanding of ionic liquid interaction with the biosphere.^[7]

Application studies include papers from Watanabe et al. on the development of glyme solvate ionic liquids for lithium batteries,^[8] while Pringle and her co-workers describe the use of ionic liquids for thermocells, demonstrating that incorporation of various ionic liquids enhance the electrochemical and mechanical properties as well as thermal energy harvesting performance.^[9]

Demonstrating the continued impact of this field in the area of catalysis, Schroeder and her group at TUWien report on the application of surface-active ionic liquids in catalytic water splitting,^[10] while Chrobok and her team, involving collaborators in Poland, QUILL, and Monash, apply protic ionic liquids based on oligomeric anions as catalysts and solvents for ϵ -caprolactam synthesis.^[11] Continuing to highlight the important application of ionic liquids in biomass valorisation, an enduring interest of Ken's, Kakibe and co-workers demonstrate the application of ionic liquids in etherification of cellulose, an important step in harvesting cellulose.^[12]

As we reflect on the incredible diversity in these articles, and the prominence of Ken's influence therein, it is clear that he will certainly be remembered as a rockstar of ionic liquids!

Conflicts of Interest

The authors declare no conflicts of interest.

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