

## Everything Under the Sun: The 11th Pacific Polymer Conference

Andrew K. Whittaker

Centre for Advanced Imaging and Australian Institute for Bioengineering and Nanotechnology, The University of Queensland, St. Lucia, Queensland 4072, Australia. Email: a.whittaker@uq.edu.au

International cooperation is essential in polymer science, as it is in all modern technological endeavours. The inherent complexity of our profession, which has arguably dramatically increased since the start of this millennium, necessitates collaboration. Furthermore, our national funding agencies are becoming increasingly directive as to which disciplines will be supported (national priorities), so that often one must look to coworkers across national boundaries to build effective and balanced research programs. For this reason the pan-national chemical societies are attracting greater interest and support. The International Union of Pure and Applied Chemistry was the first of these to be established, and is celebrating its 50th birthday with the International Year of Chemistry next year; the Polymer Division of IUPAC has traditionally been one of the stronger divisions of that society. Regional pan-national polymer societies are no less important, and tend to be less focussed on educational aspects, but rather serve the specific scientific needs of their members. Of note are the European Polymer Federation and the recently-established Federation of Asian Polymer Societies, sister organizations of the Pacific Polymer Federation (PPF).

The PPF was founded in 1987 by senior members of the polymer chemical societies of Japan, USA, and Australia to encourage and facilitate interactions between polymer organizations in the Pacific Basin. The federation has grown so that the current members are, in alphabetical order, the national polymer associations of Australia, Canada, Chile, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Singapore, Taiwan, Thailand, USA (ACS and APS), and Vietnam. The PPF meetings, the Pacific Polymer Conferences (PPC), which are held every 2 years, are the major mechanism used to foster these interactions, and so far have been held in six of the member countries. The most recent meeting, the 11th Pacific Polymer Conference (PPC11) was held in the beautiful city of Cairns from 6 to 10 December 2009.

PPC11 was one of the largest gatherings of polymer scientists to be held in Australasia, with over 850 delegates registered and presenting 1050 papers in 10 parallel oral sessions and two poster sessions. PPC11 also incorporated several other meetings, namely the 31st Australasian Polymer Symposium, Organic and Polymer Solar Cells and the Inaugural Australian Microplasma Workshops, and the 2nd International Symposium on Ultimate Stability of Nanostructured Polymers and Composites. In addition the program included sessions organized on behalf of RADTECH Asia. The largest number of delegates, 240, originated from Australia; however, as is evidenced by the articles in this Research Front large numbers of scientists from Japan, Europe, and USA were also in attendance.

The papers presented in this Research Front exemplify the diversity of polymer science, with papers covering subjects ranging from fundamental chemical sciences, to structural and functional materials, to applications in biomedical sciences. Australia has built a reputation in innovation in free radical polymerization methods and the study of mechanisms of polymerization, and so it is especially apt that the highlight article of Research Front is by Franck D'Agosto and Christophe Boisson,<sup>[1]</sup> who in their paper draw analogies between the more-familiar controlled radical polymerization, and catalyzed chain growth polymerization for control of olefin polymerization. Kobayashi and colleagues<sup>[2]</sup> demonstrated the use of ring-opening metathesis polymerization for formation of polyolefins, through the reaction and subsequent hydrogenation of 5-hexyl-1-cyclooctene and cyclooctadiene. The polymers are of utility for studying the effect of branching on the physical properties of polyolefins. While such synthetic advances are of great value, the work of Michelle Coote and her team<sup>[3]</sup> remind us of the power of computational methods through her study of the radical ring-opening polymerization of diphosphetanes.



Andrew Whittaker obtained his B.Sc. and Ph.D. from the University of Queensland in the group of Jim O'Donnell, subsequently obtaining postdoctoral experience at the USTL, Montpellier with Patrick Bernier and the MPIP, Mainz with Hans Spiess. He subsequently spent 3 years at BP Research, Sunbury-on-Thames working on solid-state NMR of polymers of interest to that company. In 1991, he returned to the University of Queensland where he was a research scientist within the Centre for Magnetic Resonance, and since 2005 has been a Professorial Research Fellow and Group Leader within CMR (now the Centre for Advanced Imaging) and the Australian Institute for Bioengineering. He leads a group of 40 scientists working on the application of magnetic resonance methods, polymeric biomaterials, and polymers for lithography. He has published over 200 refereed journal papers and over 300 conference papers. Among other activities he has been Chair of the RACI Polymer Division and is the immediate past-president of the Pacific Polymer Federation.

The flexibility of nitroxide chemistry, exploited with note in the past by several leading Australian scientists, is illustrated in three papers in this Research Front. Marchand and her colleagues<sup>[4]</sup> investigated the reactivity of various aldehyde-based nitroxides towards nitroxide-mediated polymerization (NMP) of styrene and *n*-butyl acrylate as opposed to the established system SG1. Selection of the nitroxide structures was based on structure–property relations already established by that group. Per Zetterlund<sup>[5]</sup> has investigated whether the segregation inherent in compartmentalization effects in NMP can be reproduced by polymerization in dilute solution. His work on polymerization of styrene using either of two nitroxides demonstrates that such an approach cannot match the kinetics of heterogeneous polymerization. In an elegant paper Kulis and coworkers<sup>[6]</sup> report the use of the so-called single electron transfer-nitroxide radical coupling (SET-NRC) reaction to very rapidly produce multi-block copolymers. The NRC reaction is reversible at higher temperatures, and hence enables substitution of the end-group with nitroxides functionalized with moieties such as alkyne groups available for further chemistry.

The theme of functional polymers including polymeric biomaterials is explored in several papers; Theato and Klinger<sup>[7]</sup> reported the reversible addition–fragmentation chain transfer (RAFT) and NMP polymerization of block copolymers including monomers containing the 1-iminopyridinium ylide functionalities. These are known for their photoreactivity. Several interesting block copolymers are reported by them. Duong et al.<sup>[8]</sup> have reported the RAFT polymerization of self-assembling block copolymers of polyethylene glycol (PEG)-methacrylate and styrene initiated from the hydrophilic macro-RAFT agent. The assembled micelles were core-crosslinked through reaction with a difunctional monomer, and the final materials shown to be non-cytotoxic. RAFT polymerization was also used by Jingquan Liu and coworkers<sup>[9]</sup> to produce PEG-acrylate polymers with cholesterol-functionalized end-groups. The RAFT end-group enabled complexation to gold nanoparticles, with the cholesterol group further complexed with  $\beta$ -cyclodextrin. Chapman et al.<sup>[10]</sup> have reported the coupling via the Huisgen 1,3-dipolar cycloaddition reaction of an alkyne-end-functionalized polyacrylate to an azide-functional cyclic peptide. The efficiency of the coupling reaction was examined and found to be sensitive to the molar mass of the polymer. Our cover image illustrates the work of Ma et al.,<sup>[11]</sup> who described the formation of antifouling materials via the thiolene-crosslinking of fluorinated-backbone polymers. The polymers, prepared using RAFT polymerization incorporated a pendant alkene unit available for photo-initiated thiolene reactions. The work nicely illustrates how several advanced chemistry concepts can be exploited in materials design. To demonstrate the more applied aspects of polymeric biomaterials, Nisbet and his colleagues have written an extensive and comprehensive review<sup>[12]</sup> of the application of polymeric material to the repair of neurological tissue, which will be of continued value to the tissue engineering community.

The program of the PPC11 also included many papers on polymer physical chemistry and characterization. For example,

Hoogenboom and coworkers have presented<sup>[13]</sup> a study of the interesting upper-critical solution behaviour of poly(methyl methacrylate) in mixed alcohol-water solvents. This very careful study examined the effect of molar mass and of copolymer composition on solution properties. The thermal and crystallization properties of  $\alpha$  isotactic polypropylene have been reported by Phillips et al.<sup>[14]</sup> The authors have used several techniques notably both small-angle X-ray scattering and rheo-WAXS to examine in exquisite detail the complex reorientation behaviour of the crystalline lamellae under shear. Marianne Gaborieau and her coworkers<sup>[15]</sup> have shown that coupling of capillary electrophoresis to electrospray ionization mass spectrometry provides a powerful tool for characterization of the small polymers and oligomers formed using the modern controlled radical polymerization methods.

This small collection of papers amply demonstrates the versatility of polymer science and the inherent multi-disciplinary nature of our field; we sincerely hope you enjoy the outstanding science presented within these pages. Finally, on behalf of my meeting co-chair Professor Wayne Cook (Monash University) and the chair of the hosting organization, the RACI Polymer Division, Professor Martina Stenzel (University of New South Wales), I would like to extend my sincere thanks to the *Australian Journal of Chemistry* for their continued support of our vibrant scientific community, and to the delegates of PPC11 for supporting the federation. We trust that you will join us at PPC12 in Jeju Island in November 2011.

## References

- [1] F. D'Agosto, C. Boisson, *Aust. J. Chem.* **2010**, *63*, 1155. doi:10.1071/CH10098
- [2] S. Kobayahi, C. W. Macosko, M. A. Hillmyer, *Aust. J. Chem.* **2010**, *63*, 1201. doi:10.1071/CH10039
- [3] M. L. Coote, M. Namazian, S. B. Wild, *Aust. J. Chem.* **2010**, *63*, 1189. doi:10.1071/CH10085
- [4] J. Marchand, L. Autissier, Y. Guillaneuf, J.-L. Couturier, D. Gimes, D. Bertin, *Aust. J. Chem.* **2010**, *63*, 1237. doi:10.1071/CH10123
- [5] P. B. Zetterlund, *Aust. J. Chem.* **2010**, *63*, 1195. doi:10.1071/CH10063
- [6] J. Kulis, C. A. Bell, A. S. Micallef, M. J. Monteiro, *Aust. J. Chem.* **2010**, *63*, 1227. doi:10.1071/CH10092
- [7] P. Theato, D. Klinger, *Aust. J. Chem.* **2010**, *63*, 1164. doi:10.1071/CH10079
- [8] H. T. T. Duong, T. L. U. Nguyen, J. Kumpfmüller, M. H. Stenzel, *Aust. J. Chem.* **2010**, *63*, 1210. doi:10.1071/CH10127
- [9] J. Liu, E. Setijadi, Y. Liu, M. R. Whittaker, C. Boyer, T. P. Davis, *Aust. J. Chem.* **2010**, *63*, 1245. doi:10.1071/CH10091
- [10] R. Chapman, K. A. Jolliffe, S. Perrier, *Aust. J. Chem.* **2010**, *63*, 1169. doi:10.1071/CH10128
- [11] J. Ma, J. W. Bartels, Z. Li, K. Zhang, C. Chong, K. L. Wooley, *Aust. J. Chem.* **2010**, *63*, 1159. doi:10.1071/CH10011
- [12] J. T. S. Pettikiriachchi, C. L. Parish, M. S. Shoichet, J. S. Forsythe, D. R. Nisbet, *Aust. J. Chem.* **2010**, *63*, 1143. doi:10.1071/CH10159
- [13] R. Hoogenboom, C. R. Becer, C. Guerrero-Sanchez, S. Hoepfner, U. S. Schubert, *Aust. J. Chem.* **2010**, *63*, 1173. doi:10.1071/CH10083
- [14] A. Phillips, P. Zhu, C. Hadinata, G. Edward, *Aust. J. Chem.* **2010**, *63*, 1179. doi:10.1071/CH10080
- [15] M. Gaborieau, T. J. Causon, Y. Guillaneuf, E. F. Hilder, P. Castignolles, *Aust. J. Chem.* **2010**, *63*, 1219. doi:10.1071/CH10088