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The Inaugural Australian Workshop on Bioconjugate Chemistry, UNSW 2008

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The Research Front in this issue of the *Australian Journal of Chemistry* is dedicated to Bioconjugate Chemistry, an interdisciplinary field concerned with developing efficient methods for the chemical modification of biological molecules which encompasses both in vitro and in vivo applications.[1,2] The motivation for this Research Front emerged from the very successful Inaugural Australian Workshop on Bioconjugate Chemistry held at the University of New South Wales in March 2008. The list of speakers included Professor Alan Rowan from the University of Nijmegen, The Netherlands, Dr Volga Bulmus, Dr Jingquan Liu, and Professor Justin Gooding from the University of New South Wales, Dr Richard J. Payne and Dr Wenrong Yang from the University of Sydney, Professor Nick Dixon from the University of Wollongong, and Professor Paul Alewood from the University of Queensland. The workshop also included two talks from Ph.D. students: Brendon Conlan from the Australian National University and Joshua Peterson from the University of New South Wales. Several of the workshop delegates have contributed to this issue. The results disseminated in this issue highlight the current burst of activity and breakthroughs that have been made, both in Australia and internationally. Perhaps this is not surprising given the necessity of efficient and cutting edge bioconjugation strategies in a wide range of disciplines including biotechnology, nanotechnology, chemistry, materials sciences as well as single-molecule/enzyme studies. The researchers that have contributed to this issue come from a range of specialty areas including peptide and protein chemistry, polymer chemistry, photo(bio)chemistry, electrochemistry, and nanotechnology, illustrating the diverse nature of bioconjugate chemistry that is presented in this Research Front.

The development of biosensors has been one of the key driving forces for several research groups working in the area of electrochemistry, bioelectronics, and nano(bio)technology. The key challenges in integrating biological molecules into biosensors concerns methods used to link or anchor proteins or other biomolecules to surfaces. The review by Goldstein, Thordarson, and Peterson highlights some of the recent work concerning the conjugation of redox active proteins to novel electrode materials, including carbon nanotubes, metallic nanoparticles, and graphene.[3]

The construction of biosensors usually necessitates that biomolecules are linked to artificial (synthetic) surfaces. However, there have been several recent developments allowing for the covalent derivatisation of DNA with proteins, an area discussed by Schaeffer and Dixon in their Highlight article.[4] These DNA–protein bioconjugates are of immense value in aiding our fundamental understanding of protein–DNA interactions, for example in gene expression as well as wide ranging applications in novel diagnostic devices.

Bioconjugate chemistry can also help us understand other fundamental processes in biology, including photosynthesis. Harnessing the power of photosynthesis in bio-hybrid devices could also help address some of the challenges we currently face in reducing our dependence on fossil fuels. The paper by Wydrzynski and co-workers illustrates how a bacterioferritin protein, modified with zinc-chlorin and manganese ions, can

Pall Thordarson was appointed as a Senior Lecturer at the University of NSW in 2007, where he leads a research group of 10 working on self-assembled gels for drug delivery and light-activated bioconjugates for biosensors and energy production.

Richard J. Payne was appointed as a Lecturer within the School of Chemistry at the University of Sydney in 2008. His current research interests include tuberculosis drug discovery, carbohydrate chemistry, and synthesis of post-translationally modified peptides and proteins.

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help us better understand the ability of Photosystem II (PSII) to oxidize water to molecular oxygen.[5]

Our ability to directly manipulate biomolecules, including proteins, DNA and RNA also has enormous implications in medical research. The relatively recent discovery of small interfering RNA (si-RNA) that can inhibit gene expression has resulted in a flurry of research in methods that could utilize si-RNA for the treatment of various diseases and disorders, including cancer. Bulmus and co-workers describe the formation of stable non-covalent complexes between si-RNA and a specially synthesized block copolymer (obtained by RAFT).[6] The results presented indicate that this approach could address some of the key issues that currently hamper in vivo use of si-RNA due to difficulties with its delivery.

The Research Front also features a communication from Chun and Payne describing the synthesis of peptide and glycopeptide dendrimers.[7] The goal of this study was to utilize rapid and efficient chemistry to generate dendrimers presenting a multivalent array of immunogenic peptide segments of a glycoprotein called MUC1, which is overexpressed on several epithelial tumour cell types. This was achieved by using the copper-catalyzed azide–alkyne cycloaddition reaction (CuAAC) (the quintessential 'click reaction') to conjugate a dendrimer scaffold bearing terminal alkyne groups with peptides and glycopeptides bearing azide moieties. The multivalent peptide and glycopeptide dendrimers were produced in high yields and purities and serve as potential candidiates for the development of cancer vaccines.

Finally, this Research Front features a communication from Alewood and co-workers which describes the use of peptide ligation chemistry for the efficient construction of chimeras of ω-conotoxin.[8] Specifically, native chemical ligation was used for the synthesis of four full-length ω-conotoxins by disconnecting the sequence at several ideally situated cysteine residues. Notably, this novel synthetic route to these bioactive molecules proved to be higher yielding and afforded peptides of higher purity than those synthesized in one piece by solid-phase peptide synthesis. The results of this study may therefore have enormous scope and utility in the synthesis of other members of the conotoxin family or in the ligation based assembly of other bioactive peptides.

We thank the School of Chemistry and the Centre for Advanced Macromolecule Design at the University of New South Wales for sponsorship of the Bioconjugate Workshop. We hope that you enjoy reading the articles in this Research Front, and encourage you to join us at the next meeting.

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