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Foreword

RACI and Academy of Science Awards 2017-18

Curt Wentrup

School of Chemistry and Molecular Biosciences, The University of Queensland, Brisbane, Qld 4072, Australia. Email: wentrup@uq.edu.au

Once again, *Aust. J. Chem*. is pleased to publish a special issue containing papers authored by winners of awards and medals from the Royal Australian Chemical Institute (RACI) and the Australian Academy of Science (AAS).

Katrina Jolliffe (The University of Sydney) was the winner of the 2017 Arthur Birch Medal of the Organic Division of the RACI. In her review on the pseudoproline approach to peptide cyclisation she describes the development of efficient methods for the synthesis of cyclic peptides. Pseudoprolines are derived from serine, threonine, and cysteine, and can be used as traceless turn-inducers to facilitate cyclisation. A pseudoproline usually results in a faster and higher-yielding cyclisation. The turn-inducers can be removed again after the cyclisation and have been employed in syntheses of cyclic peptides containing serine, threonine, cysteine or alanine moieties.[1]

Mark Humphrey (ANU) won the RACI's 2017 Leighton Memorial Award. In an Account, he describes the highly-efficient use of ruthenium alkynyl complexes in nonlinear optics, where dipolar species exhibit record values of quadratic optical nonlinearity, and specific octupolar ruthenium alkynyl stars and dendrimers show record values of cubic optical nonlinearity and multiphoton absorption cross-sections. Protonation/deprotonation, oxidation/reduction, and photoisomerisation stimuli were employed at certain ruthenium alkynyl complexes to demonstrate NLO switching across a record number of states.[2]

Brett Hallam (UNSW) received a J. G. Russell Award from the AAS. In an Account on 'Overcoming the Challenges of Hydrogenation in Silicon Solar Cells', he and his colleagues describe the challenges of passivating defects in silicon solar cells using hydrogen atoms. Atomic hydrogen is naturally incorporated into conventional silicon solar cells through the deposition of hydrogen-containing dielectric layers and the metallisation firing process. The firing process can readily passivate certain structural defects such as grain boundaries. However, the standard hydrogenation processes are ineffective at passivating numerous defects in silicon solar cells. This difficulty can be attributed to the atomic hydrogen naturally occupying low-mobility and low-reactivity charge states, or the thermal dissociation of hydrogen defect complexes. The concentration of the highly mobile and reactive neutral charge state of atomic hydrogen can be enhanced using excess carriers generated by light. Additional low-temperature hydrogenation processes implemented after the conventional fast-firing hydrogenation process are shown to improve the passivation of difficult structural defects.[3]

Liam Burt (University of Tasmania) was awarded the Masson Memorial Scholarship, and in a Highlight co-written with his supervisor, Curtis Ho, on high oxidation states of organopalladium(IV) species, it is recalled that the synthetically versatile palladium-catalysed couplings usually employ palladium (0)/palladium(II) catalysis, and there is much less knowledge of palladium(II)/palladium(IV) pairs. The Highlight focuses on seminal discoveries in organopalladium(IV) chemistry and their applications in palladium catalysis, particularly C–H activation.[4]

Alex Bissember (University of Tasmania) received the RACI's 2017 Organometallic Award. He reviews the natural products isolated from endemic Tasmanian vascular plants, of which 530 are known, but only ~5 % have been investigated. Nonetheless, a wide variety of products, including furans, phenolics, pyrones, quinones, alkaloids, terpenoids, steroids, and polyynes have been characterised.[5]

Martina Stenzel (UNSW) was awarded the 2017 H. G. Smith Medal of the RACI. In a Review, she describes how therapeutic proteins have made an impact in the drug market, but since proteins are subject to quick hydrolytic degradation or denaturation, they require a protective layer. Mixing block copolymers and proteins is an easy way to encapsulate the charged payload in nanoparticles. The resulting polyion complex micelles, PIC micelles, are stable in aqueous solution while the protein is

Curt Wentrup was educated at the University of Copenhagen (Cand. Scient. 1966; D.Sc. 1976) and the Australian National University (Ph.D. 1969). After post-doctoral periods with Hans Dahn (Lausanne), W. M. Jones (Gainesville, FL) and Maitland Jones, Jr (Princeton), he held junior positions at the Université de Lausanne, Switzerland, and a professorship at the Universität Marburg, Germany, before returning to Australia in 1985 as Professor and Chair of Organic Chemistry and head of the organic chemistry section at the University of Queensland, where he is now Emeritus Professor. He has published nearly 500 research papers, reviews, and books on reactive intermediates and unusual molecules, and is still highly active in international research collaborations. He is a Fellow of the Australian Academy of Science and a recipient of the Centenary Medal of the Australian Commonwealth for research in organic and physical chemistry, the David Craig Medal of the Australian Academy of Science for research in chemistry, the Arthur Birch Medal of the Royal Australian Chemical Institute for excellence in organic chemistry, and an honorary doctorate from the Université de Pau, France.

protected against degradation. This approach can be used to deliver therapeutic proteins and to stabilise enzymes.[6]

Douglas MacFarlane was awarded the 2018 David Craig Medal of the AAS. In a paper with Ciaran McDonnell-Worth, he reviews direct hydrogen peroxide fuel cells (DHPFCs), which use electrochemically generated H_2O_2 and are well suited for renewable energy storage and transportation. Here, H_2O_2 acts as both the fuel and the oxidant, and the DHPFCs can be designed to be membraneless and fully reversible.[7]

Michael Kassiou (The University of Sydney) was the winner of the 2017 Adrien Albert Award of the Medicinal Chemistry Division of the RACI.[8] His paper deals with analogues of the 7-azaindole DYRK1A – a novel target for EGFR-dependent glioblastoma of promise in cancer therapy. DYRK1A inhibition has been found to promote EGFR degradation in glioblastoma cells by triggering the endocytosis and lysosomal degradation, thus reducing the self-renewal ability of tumorigenic cells. A set of novel ring-opened compounds were prepared and tested, and mechanistic pathways leading to apoptosis of glioblastoma cells are discussed.

Mary Garson (The University of Queensland) was the recipient of the inaugural Margaret Sheil Award for Leadership in Chemistry. Her contribution describes the determination of the structure, by NMR spectroscopy, of a rearranged, oxygenated spongian diterpene, chromolactol, isolated from the Indo-Pacific nudibranch *Goniobranchus coi*.[9] The characterisation was aided by molecular modelling and DFT calculations, and a biosynthetic pathway to the preferred stereoisomer was also proposed.

Amir Karton (The University of Western Australia) received the 2018 Le Fèvre Medal of the AAS. The question in the title of his research paper, 'Can Popular DFT Approximations and Truncated Coupled Cluster Theory Describe the Potential Energy Surface of the Beryllium Dimer?' is investigated computationally using density functional theory (DFT). An accurate potential energy surface for the beryllium dimer was determined, and this data was used to evaluate the performance of approximate DFT and coupled cluster methods.[10]

Lydia Matesic (Australian Nuclear Science and Technology Organisation) was awarded the 2017 Rita Cornforth Lectureship from the RACI. Her paper reports the selective fluorine-18 labelling of the muscarinic M_2 imaging agent $[^{18}F]$FP-TZTP using continuous flow microfluidics. When scaled up to production-level quantities, the $[^{18}F]$FP-TZTP was obtained with good radiochemical yield and molar activity by using decreased amounts of reagents.[11]

Debbie S. Silvester (Curtin University) was awarded the 2017 Peter W. Alexander Medal for early career excellence in analytical chemistry. In a contribution with J. Lee and C. E. Hay, she describes a mechanistic investigation of electrochemical reduction of 2,4-dinitrotoluene in ionic liquids at room temperature. The observation of two distinctive reduction peaks correspond to the stepwise reduction of the two nitro groups. The first step becomes chemically irreversible at increasing concentration, and simulations suggest the subsequent dimerisation of the radical anion, and/or abstraction of a proton from another DNT molecule.[12]

Greg Qiao (The University of Melbourne) won the RACI's 2017 Applied Research Award. He reports a new methodology for the Fenton cancer therapy, whereby MOF nanoparticles were PEGylated via the surface-initiated atom transfer radical polymerisation (SI-ATRP) reaction to produce a PEGylated, reduced MOF (P@rMOF). The nanoparticles were further conjugated with folic acid for cell targeting. In-vitro cell uptake experiments demonstrated that the internalisation of 2P@rMOF-FA nanoparticles into cancer cells (HeLa) was almost 3-fold higher than that of normal cells (NIH-3T3), and the selectivity index for 2P@rMOF-FA, 4.48, is significantly higher than literature values. Thus, the work demonstrates the most stable and selective nanoparticle system for the treatment of cancer cells using the cell's own H_2O_2.[13]

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