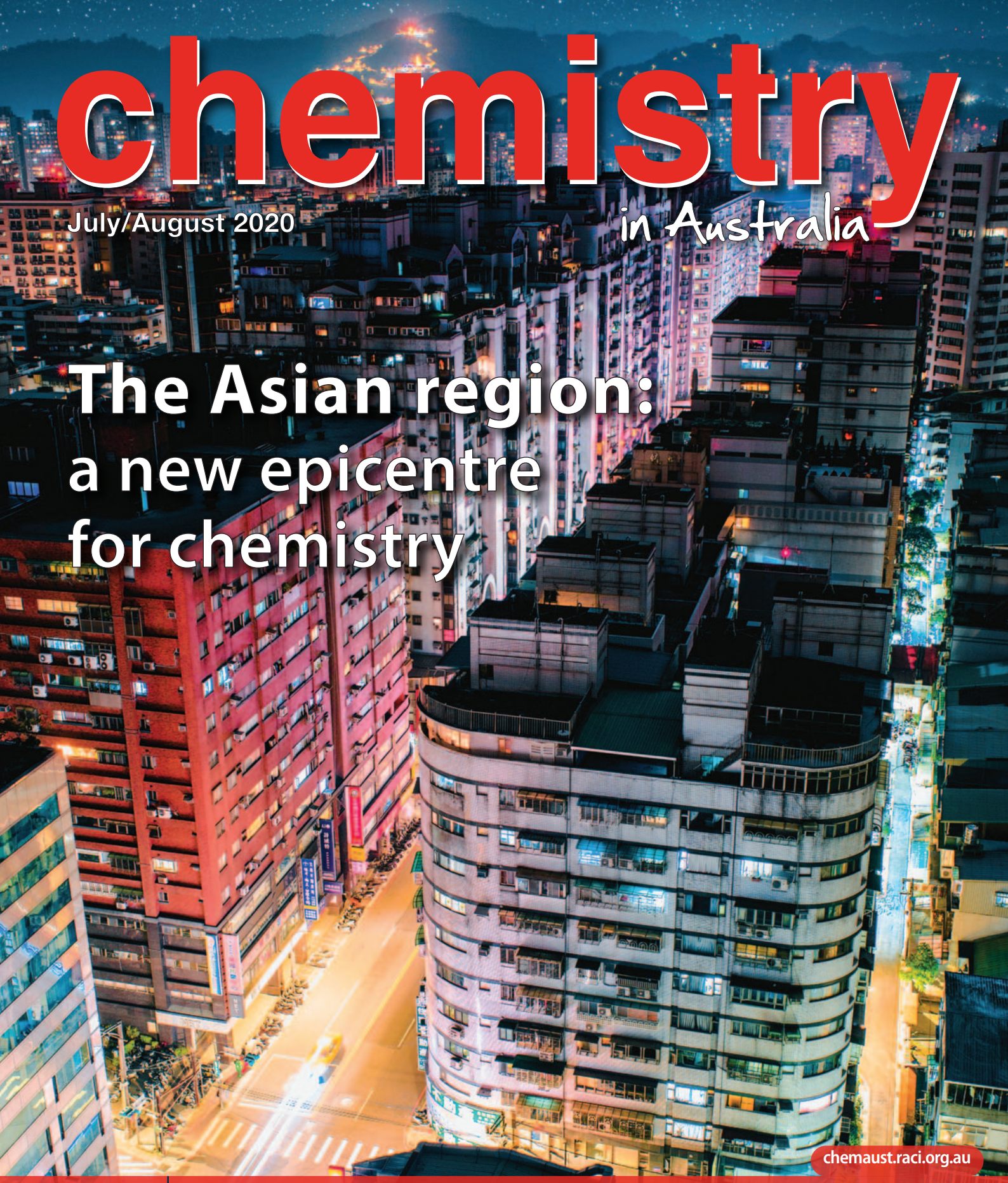
chemistry in Australia
July/August 2020



The Asian region: a new epicentre for chemistry

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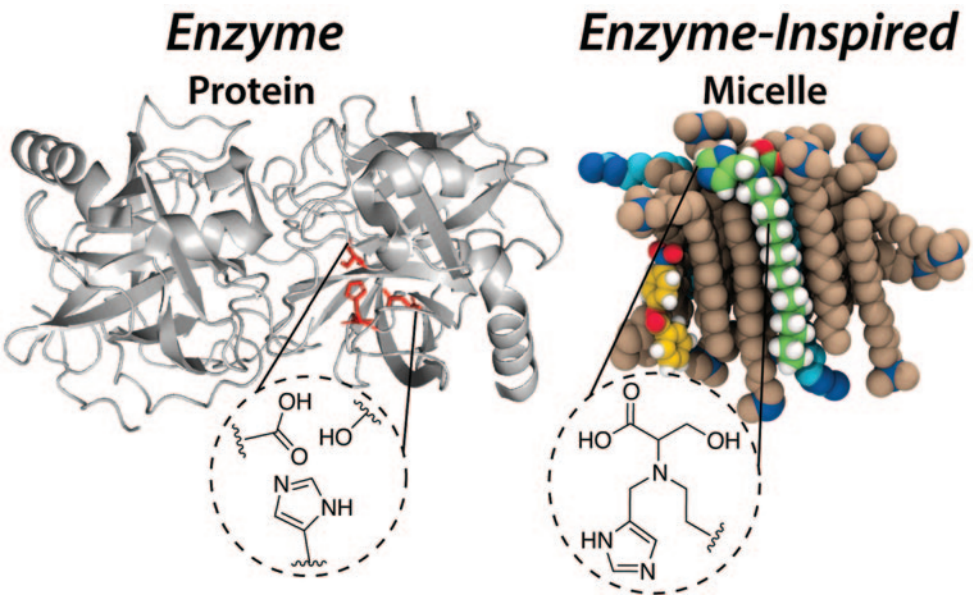
Enzyme-inspired self-assembling surfactant catalysts

Enzymes carry out their life-giving reactions by gathering together a remarkably intricate arrangement of functional groups. It is the precisely defined protein structure of enzymes that establishes these interactions. However, it is also this protein structure that makes enzymes susceptible to deactivation by heat, salts and organic solvents. This problem has sparked interest in the design of enzyme-inspired catalysts that collect complimentary functionalities without relying on delicate protein assemblies. A diverse team of researchers from the Australian National University and the University of Melbourne has recently developed a new, enzyme-inspired catalyst system that employs multi-functional surfactants to carry out catalysis (Nothling M.D., Xiao Z., Hill N.S., Blyth M.T., Bhaskaran A., Sani M., Espinosa-Gomez A., Ngov K., White J., Buscher T., Separovic F., O'Mara M.L., Coote M.L., Connal L.A. *Sci. Adv.* 2020, **6**, eaaz0404). Using the hydrolase enzyme family as inspiration, the team led by Luke Connal designed a series of surfactant molecules that each incorporates specific aspects of the enzyme's functional core. When added to water, the functional surfactants self-assemble into micelles, drawing the active headgroups into proximity and amplifying their reactivity for ester hydrolysis. Experimental and computational analysis reveals exceptional rate enhancements and a catalytic mechanism similar to that of the native enzymes. These findings could underpin the design of new organic catalysts for challenging reaction settings, including laundry detergents and biodiesel production.



Nanomedicines for brain cancer

A key benefit of nanomedicines is their ability to be precisely tailored for specific applications, with their design informed by the individual biology of specific patients. However, functional flexibility often comes hand-in-hand with synthetic complexity, and the ability to understand the intricate interplay between synthetic materials and biology becomes increasingly important. Researchers at the University of Queensland in collaboration with scientists at CSIRO and the University of Melbourne have developed new methodologies to evaluate how nanomaterial design can significantly affect its interaction with the brain (Houston Z.H., Bunt J., Chen K.-S., Puttick S., Howard C.B., Fletcher N.L., Fuchs A.V., Cui J., Ju Y., Cowin G., Song X., Boyd A.W., Mahler S.M., Richards L.J., Caruso F., Thurecht K. *ACS Cent. Sci.* 2020, **6**, 727–38). One key factor that prevents successful treatment of brain cancers is the poor transport of therapies across the blood–brain barrier. Using simultaneous positron emission tomography/magnetic resonance imaging and coupling to complex models of brain cancer, the team was able to show that precisely engineered nanomedicines could effectively cross the blood–brain barrier and accumulate in tumour tissue. Importantly, the homogeneous distribution achieved throughout the tissue offers a glimpse into how to design better next-generation therapies, including where they might fit into a treatment regime for patients.