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Preface

George Zheng Chen ⟨http://www.nottingham.ac.uk/∼enzgzc⟩, *DIC, FRSC, FRSA, FIMMM*, is professor of electrochemical technologies in both the UK (Nottingham) and China (Ningbo) campuses of the University of Nottingham. He is also a senior academic visitor of Fudan University and a specially invited professor of Wuhan University of Science and Technology. He obtained a teaching diploma in chemistry from Jiujiang Teacher Training College in 1981, the M.Sc. degree in physical chemistry (electrochemistry) from Fujian Normal University in 1985 (supervised by Prof. Qixin Zhang), and the Ph.D. degree in physical chemistry (electrochemistry) in 1992 from University of London (supervised by Prof. W. John Albery, *FRS*, in Imperial College of Science, Technology and Medicine). He worked in the Universities of Oxford (1992–1994), Leeds (1994–96) and Cambridge (1996–2003, Darwin College), and Jiangxi (1985–1988) and Wuhan (2000–2010) Universities. Prof. Chen is the recipient of several national and international awards, including the Cheung Kong Scholarship from the Ministry of Education, China (2000), the NSFC Distinguished Young Scholar (2002), two TMS Reactive Metals Technology Awards (2001 and 2004), the Royal Society Brian Mercer Feasibility Award (2007), the E.ON International Research Award for Energy Storage (2008), the Inman Medal for Molten Salt Electrochemistry (2014), and the 1000 Talent Plan Expert of Zhejiang (2015). His research aims at electrochemical and liquid salts innovations for materials, energy and environment, producing 20 patents (including the Fray–Farthing–Chen Cambridge Process), 95 postgraduate theses, 220 peer reviewed articles in journals, books and proceedings, and over 300 invited and contributed presentations at conferences and seminars. On 01 December 2015, Web of Science reported an *h*-index of 46 and 7836 citations for his publications under the Author Identifiers of A-4577-2009 (Researcher ID).

Table 1
An overview of topics of electrochemistry for materials and energy that are covered in this special issue.

	Energy			Materials		
	Conversion and storage	Saving and efficiency	Hydrogen, solar, and nuclear	Metal and Semi-metal	Non-metal and nano-structured	Ceramic and composite
Aqueous electrolyte	Hu, Jiang, Beguim, Frackowiak,	Jiang	Jiang		Jiang, Beguim, Frackowiak,	Jiang, Hu
Organic electrolyte	Ishikawa, Wu			Ishikawa,	Ishikawa, Yury	Ishikawa
Solid electrolyte	Wu	Pal		Pal	Wu	Pal, Wu
Ionic liquid	Ishikawa, Yury	Abbott, Endres		Abbott, Endres	Ishikawa, Yury	Ishikawa, Yury
Molten salt		Fray, Jin	Jeong, Fray	Fray, Jin, Jeong	Jin	Fray, Jin, Jeong

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Promising prospects of electrochemistry in the era of renewable materials and energy

In the history of human civilisation, several significant changes and progresses have been caused by discoveries, manmade materials and technological innovations, such as copper, iron and steel, concrete, coal, oil, electrolysis, steam engine, nuclear reactor, rechargeable battery, computer and smartphone, just to mention a few. These advancements are largely based on the readily availability of fossil resources which function in two major ways: offering energy directly via combustion to human activities, and provision of energy, electrons and/or elements for making materials.

What has long been predicted, but mostly ignored, both unintentionally and intentionally, is the consequence of large scale consumption of fossil resources: the detrimental impacts on the environment due to emission of polluting and greenhouse gases, particularly CO_2, and the expected exhaustion of the non-renewable fossil resources. There are several proposed or pilot tested technical solutions to address these problems, such as oil reforming for hydrogen production, clean coal and coal gasification, and carbon capture, storage and utilisation. However, these approaches cannot stop the expected exhaustion of fossil resources, to which the long known solution is to use renewable and clean resources of which sunlight, wind, hydro and nuclear are currently most widely utilised in commercial operation. The most common outcome from commercial exploitations of these non-fossil resources is electricity or a flow of electrons driven by a voltage.

The flow of electrons can be conveniently and efficiently utilised by electrochemical techniques for both energy conversion and storage, and materials processing and production. This fact means that in the renewable and clean energy era, many fossil resources based technologies can and will be replaced by direct or indirect electrochemical processes. This anticipation forms the basis of this special issue of Progress in Natural Science: Materials International on the general topic of electrochemistry for materials and energy (EME).

I am very pleased that the collected papers in this special issue represent well in the broad area of EME. This is clearly summarised in Table 1 which also indicates that all these papers are actually covering both materials and energy issues. It is worth mentioning that Table 1 is of a personal view and not intended to be exhaustive. Thus, a careful reader will notice that several boxes in Table 1 are empty. These are not omissions of the relevant research, but it is because of the limited space in this special issue. In particular, there are fast emerging interests in electrolytic decomposition of CO_2 in molten salts to produce carbon and oxygen gas. This process has also the potential to be developed into an efficient and low cost “seasonal energy storage” technology. This new development and some others, including liquid metal battery, are regrettably not covered by this special issue, leaving an opportunity for PNS-MI to organise a second special issue on electrochemistry for materials and energy.

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