Journal of Materials Chemistry A

ROYAL SOCIETY OF CHEMISTRY

EDITORIAL

View Article Online
View Journal | View Issue

Cite this: J. Mater. Chem. A, 2022, 10, 2149

Introduction to the special issue in honour of Prof. John Kilner's 75th birthday

Stephen J. Skinner, *[a] Viola Birss, [b] Jennifer Rupp [c] and Roger A. De Souza [d]

DOI: 10.1039/d2ta90015g

rsc.li/materials-a

[a]Department of Materials, Imperial College London, Exhibition Road, London SW7 2AZ, UK. E-mail: s.skinner@imperial.ac.uk

[b]Department of Chemistry, University of Calgary, 2500 University Drive NW, Calgary, Alberta, Canada T2N 1N4. E-mail: birss@ucalgary.ca

[c]Department of Materials Science and Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139, USA. E-mail: jrupp@mit.edu

[d]Institute of Physical Chemistry, RWTH Aachen University, 52056 Aachen, Germany. E-mail: desouza@pc.rwth-aachen.de

This special issue of *Journal of Materials Chemistry A* celebrates the achievements of Professor John Kilner on the occasion of his 75th birthday. John is a materials scientist whose broad interests span the physical sciences with a focus on energy materials and the use of advanced ion beam techniques to understand key transport processes in such systems. John began his career with a degree in physics from the University of Birmingham, before completing his PhD in Metallurgy at the same institution under the supervision of Professor Rex Harris. He then moved to the University of Leeds to work with Professor Sir Richard Brook on oxygen-ion conduction in oxides,[1] before moving to Imperial College London in 1979 as a postdoctoral researcher within the Wolfson Unit for Solid State

Stephen Skinner started his career as a postdoctoral fellow at the University of Southampton, before moving to the Department of Materials at Imperial College to work with John Kilner. He was appointed Lecturer at Imperial College in 2000 and promoted to Full Professor at Imperial College in 2014. In March 2021 he was awarded a Ceres/Royal Academy of Engineering Research Chair in electrochemical devices for net zero carbon. His research interests lie in the development of new materials, particularly ion conducting oxides, for electrochemical technologies, and in the characterisation of their structural and electrochemical properties. His work links the structure and chemistry of materials under realistic operating conditions using a suite of advanced tools including diffraction, microscopy and spectroscopy combined with isotopic labelling. Stephen is a Fellow of The Royal Society of Chemistry, and the Institute of Materials, Minerals & Mining (IOM3).

Viola Birss is a Professor of Chemistry and the Scientific Director of CAESR-Tech (Calgary Advanced Energy Storage and Conversion Research Technologies), recently also holding a Tier I Canada Research Chair in Fuel Cells and Related Clean Energy Systems and leading the pan-Canadian Solid Oxide Fuel Cells Canada (SOFCC) organization. Dr Birss has been the recipient of numerous prestigious scientific awards and is a Fellow of the Royal Society of Chemistry (UK), the Royal Society of Canada, the Canadian Society for Chemistry and the Electrochemical Society, and is the author of over 300 refereed scientific publications. Dr Birss's research involves improving the performance/lifetime of PEM fuel cells using paradigm-shifting nanoporous carbon scaffold materials developed in her group, the application of highly active mixed conducting perovskite catalysts that can split water and convert CO_2 to useful products in high temperature SOECs, and the use of a range of structurally ordered nanomaterials for clean energy/environment applications.

Ionics under the guidance of the late Professor Brian Steele, MBE. At Imperial College London John promoted the development of solid oxide fuel cells and performed pioneering work on developing techniques to unambiguously determine the kinetics of mass transport processes in solids.[2] John was instrumental in translating his work on solid oxide cells into technological solutions, founding, with Profs. B. C. H. Steele, A. Atkinson and N. P. Brandon, the Imperial College spin-out company, Ceres Power,[3] which is now the internationally leading supplier of metal supported intermediate temperature solid oxide fuel cells.

During his career, John has made numerous seminal contributions to the broad field of Energy Materials, advancing the fundamental understanding of critical processes in solid state batteries and solid oxide cells, through his pioneering work on methods to directly measure the ion transport in solids. His work has transformed our understanding of the kinetics of oxygen surface exchange and diffusion in solids, of cation segregation processes at surfaces, of transport along and across grain boundaries, as well as of the effect of strain on ion mobility.

John has the ability to explain complex phenomena in a clear and inspiring manner, as evidenced in the undergraduate lecture courses he gave (for instance, on defect chemistry, electroceramics and dielectrics materials), and in the many plenary and invited talks he has given. It is also evident in the fantastic supervision he provided to over 40 PhD students and over 40 postdoctoral scholars.

Throughout his career John has been highly collaborative, welcoming numerous visiting researchers to his group, many of whom have gone on to be longstanding collaborators and international leaders in their fields. For many years John has maintained positions at CICEnerginune, Vitoria, Spain and the International Institute for Carbon Neutral Energy Research at Kyushu University, Japan. These collaborations have been extremely productive with fundamental new insights into the surface chemistry of $La_{0.6}Sr_{0.4}CoO_{3-\delta}$ determined through the application of low-energy ion scattering (DOI: 10.1039/c5ta05279c), determination of fast ion transport in double perovskites as new solid oxide fuel cell cathodes (DOI: 10.1039/b704320a) and has provided new mechanistic insights into ion transport (DOI: 10.1039/c0ee00717j) as some examples.

In addition to the contributions that John has made, and continues to make, in the area of solid oxide cells, he has also made significant contributions to the fields of sensors, batteries and permeation membranes. His recent work has focused on providing unique insights into the development of Li conducting garnet type solid state electrolytes,[4] including a focus on processing of these materials and understanding the impact of humidity on function and stability.[5]

As acknowledgement of his outstanding contributions John has been internationally recognised with the award of the Daiwa Adrian Prize for Scientific Collaboration 2016; the Somiya Award of International Union of Materials Research Societies 2012; Platinum Medal of the IOM3, 2012; Royal Society Armourers and Brasiers Award, 2005; Verulam Medal of the IOM3, 2005 and the Schoenbein Medal of the European Fuel Cell Forum, 2004.

On the occasion of his 75th Birthday we are delighted to have compiled this Special Issue of *Journal of Materials Chemistry A*, with contributions from friends and colleagues worldwide, covering the range of energy materials

Jennifer Rupp is an Associate Professor of Solid State Electrolytes at TU Munich and CTO of TUM International Energy. Prior she was associate and assistant professor at MIT and a non-tenure track assistant professor at ETH. Her research is in designing "ceramic" materials and their properties for device functions in energy and computation. Rupp is a Fellow of the Royal Society of Chemistry, and received several honors with her team such as the Plaque for Battery Achievements from Samsung 2021, Displaying Future Award by Merck 2018 for a glucose converting fuel cell chip, BASF and Volkswagen Science Award 2017 for battery research, "Top 40 international scientist under the age of 40" by World Economic Forum 2015 and others. Currently, she is associate editor at the Journal of Materials Chemistry A. She also serves industry such as being advisory board member for the company Unifrax or for journals like Matter and Advanced Functional Materials.

Roger A. De Souza obtained a B. Eng. in Material Science and Engineering in 1992 and a PhD in Materials Science in 1996 from Imperial College London, the latter under the supervision of Prof. John Kilner. After spending two years at the University of Karlsruhe, he moved to the Max-Planck Institute for Solid State Research in Stuttgart. In 2002 he joined the Institute of Physical Chemistry at RWTH Aachen University, where he received his professorial degree (Habilitation) in 2011 and was promoted to Professor in 2017. The De Souza group performs fundamental research, encompassing both experimental and computational approaches, on complex materials for energy and information technologies. One particular theme is characterising, understanding and tuning transport processes in these materials and at their extended defects.

that John has devoted his career to, and reflecting the continuing growth of interdisciplinary research to tackle the challenges associated with the transition to zero pollution energy technologies.

References

1 J. A. Kilner and R. J. Brook, *Solid State Ionics*, 1982, **6**, 237–252.
2 J. A. Kilner, B. C. H. Steele and L. Ilkov, *Solid State Ionics*, 1984, **12**, 89–97.
3 B. C. H. Steele, A. Atkinson, J. A. Kilner, N. P. Brandon and R. A. Rudkin, *UK Pat.*, GB2368450, 2004.
4 E. E. Jay, M. J. D. Rushton, A. Chroneos, R. W. Grimes and J. A. Kilner, *Phys. Chem. Chem. Phys.*, 2015, **17**, 178–183.
5 C. Bernuy-Lopez, W. Manalastas, J. M. L. del Amo, A. Aguadero, F. Aguesse and J. A. Kilner, *Chem. Mater.*, 2014, **26**, 3610–3617.