THE ARMOURERS AND BRASIERS' CAMBRIDGE FORUM

WEDNESDAY, 23RD JUNE 2021, 2–7PM

Sponsors:
AWE • Institute of Materials, Minerals & Mining
Materials Processing Institute • Rolls Royce • TWI

THE GORDON SEMINARS

2.00 *Welcoming Remarks*
Professor William Bonfield *CBE FRS FREng FMedSci FIMMM*
(Past Master of the Armourers & Brasiers; Chairman of the A&B Materials Science Committee)

Session I **Chair: Professor Ruth Cameron *FInstP FIMMM***

2.10 *A century, and more, of materials research at Cambridge*
Professor A. Lindsay Greer, Dept. of Materials Science & Metallurgy, Cambridge University

On 5th October 1920, among other distinguished guests, two Nobel laureates gathered in the aroma of freshly polished benches. Sir JJ Thomson and Sir Ernest Rutherford were in support as Robert Tabor, Prime Warden of the Worshipful Company of Goldsmiths, opened the just-completed metallurgical laboratory, established as result of the Company's benefaction. That visionary moment, as the world tried to move on from the Great War and the 'flu pandemic, was perhaps not so different from our own lockdown and emergence, recognising ever more keenly the importance of research. The talk charts the amateurish ("waiting for the explosion to blow the College to atoms"), and then heroic, precursors to the Goldsmiths' Laboratory, and the research highlights over the following century. Over those years, and at every level, from undergraduate to Head of Department, Cambridge materials scientists and metallurgists have made a difference to our subject as we know it today. Long may this continue!

***Lindsay Greer** received his MA and PhD degrees from Cambridge, and holds Honorary Doctorates from AGH Cracow and from Sofia. He was Assistant Professor of Applied Physics at Harvard University, and has held visiting positions at the CEA and INP Grenoble, Washington University (St Louis), and the Universities of Vienna and Turin. He is a Foreign PI of the Advanced Institute for Materials Research, Tohoku Univ. (Sendai, Japan). He was (2006–2013) Head of the Dept. of Materials Science & Metallurgy, and (2016–2019) Head of the School of Physical Sciences at Cambridge.*
His research has ranged over electromigration, chalcogenides for phase-change data storage, fundamentals of crystal nucleation and growth, and grain refinement in alloy solidification. His current research on metallic glasses is supported by an ERC Advanced Grant. He is a co-author (with JA Charles) of 'Light Blue Materials', a history of the Cambridge Materials Dept.

2.40 *International cooperation in space — why wouldn't you?*
Dr Alice Bunn, International Director, UK Space Agency

Alice will begin by highlighting some surprising historical international partnerships in space, going on to describe how these have paved the way for broader international collaborations. She will go on to detail how our space programmes have moved from mainly the field of research and exploration, and the domain of the privileged few, to the point where societies across the world rely on space for their day-to-day lives.

As a result, space is now recognised as a strategic capability for both civil and defence purposes, where Alice will highlight some of the global and recent European challenges to cooperation.

Alice will conclude by identifying some of the exciting future opportunities in space, including for the field of materials science.

Alice Bunn *is the CEO appoint at the Institution for Mechanical Engineers. Until July 2021, she is International Director at the UK Space Agency, responsible for increasing the UK's global influence in science, security and trade through space. She leads teams responsible for ensuring international competitiveness through developing world-class skills in the UK space sector; developing multilateral and bilateral international partnerships in space; and delivering the security and resilience of the UK's infrastructure and space applications.*

Alice is head of the UK delegation to the European Space Agency; sits on the Board of Directors at the US Space Foundation; sits on the World Economic Forum Future Council on space technology; is a fellow and Council member of the Royal Aeronautical Society; and sits on the board of trustees at the charity SwimTayka. She is married, with 4 children, 1 dog and 1 cat.

Alice also has a PhD in Metallurgy from Darwin College, Cambridge.

3.10 *Adventures in product development: Materials challenges in membranes*

Dr Eilidh Bedford, CTO, Pall Life Sciences (Danaher Operating Company)

This talk is unashamedly industrially focused. I aim to describe how the principles learned in undergraduate materials science are core to product development across a broad range of industries, from cosmetics to inkjet to pharmaceuticals. I will especially use polymeric filters as an example, porous polymer membranes used to remove challenging impurities in life science and industrial applications. I will describe some of our pressing materials challenges, how we seek new technologies to solve these and what challenges we face to bring them to commercial application. Finally, I will digress to what many of us in materials science have been doing in the last year, responding to the urgency of the pandemic, bringing our membranes fast to critical applications in vaccine manufacture, ventilator filters and diagnostics. Through these examples I aim to show the challenges and rewards of materials science applied to product development.

Eilidh Bedford *is the Chief Technology Officer at Pall Life Sciences, a Materials Science company focused on solving tough customer challenges in filtration, separations and purification. Eilidh obtained her PhD in Materials Science at Cambridge within the Polymer Group, a team that still maintains close ties and ideas-sharing. She is fascinated by the application of materials science to industrial problems and has led product development teams in consumer products, pharmaceuticals and materials science Companies – ranging from multi-nationals to start ups. She lives near Boston and especially enjoys materials science as applied to new bicycles, in order to make training for the annual "Pan Mass Challenge" a little easier.*

3.40 – 4.10 ***Time to visit our posters and exhibitor booths***

Session II **Chair: Professor Serena Best *CBE FREng FIMMM***

4.10 *Brief Encounters!*

— a series of 3-minute talks by younger researchers

4.40 *Caught in the act: understanding how crystals grow by watching the movies*

Prof. Frances Ross, Dept. of Materials Science & Engineering, MIT, Cambridge MA

We can watch crystals grow in an electron microscope by adding atoms one at a time onto a clean surface. The movies tell us a lot about kinetics and thermodynamics but can also be entertaining, frustrating, or both at the same time. I will attempt to share the joy of this type of 'in-situ' microscopy as we aim to understand how atoms assemble into nanowires or nanocrystals and use the information to control the formation of more complicated nanostructures whose properties might make them useful for new types of electronic devices.

Frances M. Ross *is Ellen Swallow Richards Professor in Materials Science and Engineering at the Massachusetts Institute of Technology in Cambridge, MA, USA. She received her B.A. in Physics and Ph.D. in Materials Science from Cambridge University, UK, where she became captivated by electron microscopy. She continued this interest during her postdoc at A.T.&T. Bell Laboratories, as a Staff Scientist at the National Center for Electron Microscopy, Lawrence Berkeley National Laboratory, and as a Research Staff Member at the IBM T. J. Watson Research Center. Her research is based around the development of in-situ electron microscopy techniques to help understand crystal growth, epitaxy, self-assembly and electrochemical and other liquid phase processes.*

Chair: Professor William Bonfield *CBE FRS FREng FMedSci FIMMM*

5.10 *Armourers & Brasiers' Materials Science Venture Prize 2021*

— presented by **Mr Mike Goulette *FREng*** (Master of the Armourers & Brasiers' Company)

5.25 - 5.35 ***Short break***

THE TWENTY-SECOND KELLY LECTURE

Chair: Professor Sir Harry Bhadeshia *FRS FREng*

5.35 *Sustainable metals*

Professor Dierk Raabe

Director, Max-Planck-Institut für Eisenforschung, Düsseldorf, Germany

Metallic alloys have enabled progress over millennia. Today we produce 2 billion tons of metals every year, with this rate predicted to possibly triple by 2050. Metals require a lot of energy for their extraction and manufacture, and these processes emit large amounts of greenhouse gases and pollution. The success of metals thus brings them into a position where they have an important role in addressing the rapidly worsening environmental crisis. The presentation discusses clear pathways for improving the direct sustainability of structural metals, in areas including reduced-carbon-dioxide primary production, recycling, scrap-compatible alloy design, contaminant-tolerance of alloys and improved alloy longevity. The lecture also discusses the effectiveness and technological readiness of individual measures, and shows how novel structural materials enable improved energy efficiency.

Dierk Raabe studied music, metallurgy and metal physics. After his doctorate (1992) and habilitation (1997) at RWTH Aachen, he worked 1997–99 at Carnegie Mellon University in Pittsburgh PA and at the National High Magnetic Field Lab in Tallahassee FL. He joined the Max Planck Society as a director in 1999. His interests lie in the design of metallic alloys; computational materials science and materials theory; sustainable metallurgy; structure-property relations of materials; and atom-probe tomography. He has received the highest German science award (Leibniz Prize) and an ERC advanced grant. He is a member of the

German National Academy Leopoldina, Senator of the Helmholtz Society, Professor at RWTH Aachen, and Honorary Professor at the Katholieke Universiteit in Leuven.

6.35 **Vote of Thanks: Professor Julian Allwood *FREng***, Department of Engineering, Cambridge University

7.00 **Close of on-line meeting**