UNIVERSITY OF OXFORD
Department of Materials
Parks Road, Oxford OX1 3PH
Tel: 01865 273700, Fax: 01865 273789

COLLOQUIA – MICHAELMAS TERM 2019

VENUE: **Hume Rothery Lecture Theatre**

Refreshments will be served in the Hume Rothery Building Reception Foyer from 3:30 p.m.

Week	*Date*	*Colloquium Title and Abstract*	*Host:*
1	Thursday, 17 October	**Professor Joseph Minervini**, Assistant Director and Senior Research Engineer Plasma Science & Fusion Centre, MIT **Superconducting Technology for Fusion Energy** The world scientific community has spent decades developing and refining magnetic confinement fusion theory and experimental devices for the ultimate goal of safely, effectively, and economically generating power from a nuclear fusion reaction. Magnet systems are the ultimate enabling technology for these types of fusion devices. Powerful magnetic fields are required for confinement of the plasma, and, depending on the magnetic configuration, dc and/or pulsed magnetic fields are required for plasma initiation, ohmic heating, inductive current drive, plasma shaping, equilibrium, and stability control. Almost all design concepts for power producing commercial fusion reactors rely on superconducting magnets for efficient and reliable production of these magnetic fields. Future superconducting magnets for fusion applications require improvements in materials and components to significantly enhance the feasibility and practicality of fusion reactors as an energy source. This lecture presents the fundamentals of superconductors and magnets that makes them attractive for use in fusion device. Examples are drawn from present operating fusion tokamak, helical, and stellarator machines that use low temperature superconductors. I will also introduce the use of high temperature superconductors for future magnetic fusion devices, and how it may strongly influence the performance of fusion reactors.	CRMG

Week	Date	Colloquium Title and Abstract	Host:
3	Thursday, 31 October	Dr Ben Britton, Imperial College, London **Advancing Electron Backscatter Diffraction** Electron backscatter diffraction (EBSD) is a commonly found microscopy technique, used to explore crystalline microstructures. In this talk, I will discuss analysis of metals and geo-materials with EBSD and focus on some recent developments. We will start exploring how indexing and mapping can be performed using AstroEBSD – a new open source tool that we have developed [1]. Next, we will briefly explore mapping elastic strain and lattice rotation variations, and the calculations of stored dislocation content in metals [2] and geo-materials [3]. Next, we will consider new methods of pattern analysis including refined template matching [4] and spherical EBSD [5]. Finally, we will venture into "big data" and explore using supervised and unsupervised machine learning approaches [6]. **Biography:**Dr Ben Britton is a Senior Lecturer (equivalent to an Associate Professor) and Royal Academy of Engineering Research Fellow. As a materials scientist and engineer, based at Imperial College London (and also an academic visitor in Oxford), he leads the experimental micromechanics group. Collectively they collaborate to develop new understanding using micromechanical characterisation of materials used in aerospace, oil & gas, and nuclear power applications. He has been developing EBSD methods for over 12 years, which started his DPhil at the University of Oxford. [1] Thomas Benjamin Britton, Vivian Tong, Jim Hikey, Alex Foden, and Angus Wilkinson "AstroEBSD: exploring new space in pattern indexing with methods launched from an astronomical approach" Journal of Applied Crystallography (2018) https://doi.org/10.1107/S1600576718010373 (& preprint https://arxiv.org/abs/1804.02602) [2] Britton, T.B., Jiang, J., Karamched, P.S., and Wilkinson, A.J. Probing deformation and revealing microstructural mechanisms with cross-correlation-based, high-resolution electron backscatter diffraction JOM (2013) http://dx.doi.org/10.1007/s11837-013-0680-6 [3] David Wallis Lars N. Hansen T. Ben Britton Angus J. Wilkinson High-angular resolution electron backscatter diffraction as a new tool for mapping lattice distortion in geological minerals https://eartharxiv.org/mbwf6/ and https://arxiv.org/abs/1904.08393 , and https://doi.org/10.1029/2019JB017867 Journal of Geophysical Research - Solid Earth (2019) [4] Alexander Foden, David Collins, Angus Wilkinson, Thomas Benjamin Britton "Indexing Electron Backscatter Diffraction Patterns with a Refined Template Matching Approach" https://arxiv.org/abs/1807.11313 [5] Ralf Hielscher, Felix Bartel, and T Ben Britton "Gazing at crystal balls - Electron backscatter diffraction indexing and cross correlation on a sphere" https://arxiv.org/abs/1810.03211 [6] Advancing characterisation with statistics from correlative electron diffraction and X-ray spectroscopy, in the scanning electron microscope T.P. McAuliffe, A. Foden, C. Bilsland, D. Daskalaki-Mountanou, D. Dye & T.B. Britton *to be submitted*	Clara Barker

Week	*Date*	*Colloquium Title and Abstract*	*Host:*
4	Thursday, 7 November	**C a n c e l l e d** **Professor Nicola Pugno**, University of Trento and Queen Mary University College, London **The Leonardo's legacy: Bio-Inspired Nanomechanics** The Italian artist, inventor and scientist Leonardo da Vinci (1452–1519) can probably be considered the father of bio-inspired mechanical design, as illustrated by his artificial wings and flying machines, based on bird observation and dissection. Today, 500 years from his death, bioinspiration is attracting widespread attention worldwide, both in academia and industry. This lecture provides an overview of my group's research activity at the University of Trento in line with Leonardo's legacy of bio-inspired nanomechanics, including nano and bio-inspired materials, as well as their natural evolution towards what we have defined as 'bionicomposites'.	TJM

Week	*Date*	*Colloquium Title and Abstract*	*Host:*
8	Thursday, 5 December	**Professor Rob Weatherup**, Oxford **Looking below the surface: Probing electrochemical and catalytic reactions under real-world conditions** Probing the chemical reactions occurring at electrochemical and catalytic interfaces is critical to selecting and designing improved materials for energy storage, corrosion prevention, and chemical synthesis. Soft X-ray spectroscopies can provide powerful element- and chemical-state-specific information with the required nanometer-scale interface sensitivity, but have traditionally required high vacuum conditions, impeding studies of interfaces under realistic liquid- and gas-phase environments. I will introduce several *membrane-based* approaches we have developed over recent years to bridge this pressure gap, enabling *operando* x-ray photoelectron and absorption spectroscopy (XPS/XAS) of solid-liquid and solid-gas interfaces at atmospheric pressures and above. These rely on reaction environments sealed with X-ray/electron-transparent membranes, that can sustain large pressure drops to the high-vacuum measurement chamber. I will show how these *membrane-based* approaches can be applied to study the chemical evolution of electrode-electrolyte interfaces in Li-ion batteries, and catalyst nanoparticles in atmospheric pressure environments. I will also give a perspective on future directions that will enable these techniques to be extended to ever more realistic materials systems and operating conditions. **Biography** Rob Weatherup has recently joined the Department of Materials in Oxford as an Associate Professor in energy materials. His group develops interface sensitive characterisation techniques to understand the interfacial processes involved in the synthesis and operation of materials in areas including electrochemical energy storage, heterogeneous catalysis, and electronic devices. Much of this work involves the use of international synchrotron facilities, and he has worked closely with these facilities over the last decade to extend various X-ray spectroscopy techniques to the study of materials in realistic working environments.	Joint HoDs