Personal Introduction

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Professor of Experimental Physics in the University of London.
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Personal Information

Birthdate: 7th July 1952
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Work Experience

After my PhD at the University of Hull (UK), awarded in 1978, I worked as a post-doctoral Fellow at the Ecole Polytechnique, Paris, and the Centre d'Etudes Nucleaires de Grenoble, in France (1978 – 1981) and then at the University of Linz (Austria) (1982-1983).

Returning to the UK for a permanent academic post, I became Lecturer at the University of Surrey, promoted to Reader in 1991. In 1996 I moved to Queen Mary, University of London as Professor of Experimental Physics. I served two terms as Head of the Physics Department (2001 – 2009).

Research

I am a leading expert in the physics of materials, specialising in the experimental and theoretical study of stress and strain in small volumes. This has been an underlying theme in much of my work, in developing and understanding high-pressure equipment, in understanding semiconductor strained-layer quantum wells, and in establishing design rules for elastic strained structures and plastic relaxed buffer layers. More recently, I have applied these insights to understanding the interplay between grain size and structure size in metals, bringing these two key determinants of strength into a single theoretical framework consistent with the understanding of semiconductor mechanical properties.

My main research areas are optoelectronics and optical spectroscopy, high-pressure work on diverse materials, plasticity in small volumes, and mechanical properties of graphene. In these areas, I have published nearly 300 peer-reviewed papers, with an *h* index of 42 (Web of Science). I have supervised 24 research students, all awarded their PhDs.

My Favourite Papers:

Y.W. Sun, D.J. Dunstan, C.J. Humphreys, D.G. Papageorgiou, A. San-Miguel, C. Bousige, D. Machon, P. Puech, J.E. Proctor and D.J. Dunstan, 2021, *Mechanical properties of graphene*, Applied Physics Reviews **8**, 021310.

Y. Magnin, F. Rondepierre, W. Cui, D.J. Dunstan and A. San-Miguel, 2021, *Collapse phase diagram of carbon nanotubes with arbitrary number of walls: Collapse modes and macroscopic analog*, Carbon **178**, 552-562.

F. Xie, Y. Cao, C. Ranchon, A. Hart, R. Hansen, J.E. Post, C.W. Whitney, E. Dawson-Tarr, A.J. Drew and D.J. Dunstan, 2020, *Explanation of the colour change in alexandrites*, Scientific Reports **10**, 6130.

W. Ali, D. Liu, A. Pery, N. Herrada, D. Mills, R.A. Owen, P.A. Burton, D. Dong, G. Gannaway, A.J. Bushby and D.J. Dunstan, 2020, *Nanostrain sensitivity in a wire torsion experiment*, Rev. Sci. Instrum. **91**, 013901.

D.J. Dunstan, 2016, *Validation of a phenomenological strain-gradient theory*, Philosophical Magazine Letters **96**, 305-312.

D.J. Dunstan, 2017, *The size effect in the mechanical strength of semiconductors and metals*: *Strain relaxation by dislocation-mediated plastic deformation*, Journal of Materials Research **32**, 4041-4053.

D.J. Dunstan and A.J. Bushby, 2014, *Grain size dependence of the strength of metals: The Hall-Petch effect does not scale as the inverse square root of grain size*, International Journal of Plasticity **53**, 56-65.

D.J. Dunstan, B.Ehrler, R. Bossis, S. Joly, K.M.Y. P'ng and A.J. Bushby, 2009, *Elastic limit and strain-hardening of thin wires in torsion*, Physical Review Letters **103**, 155501.

D.J. Dunstan and A.J Bushby, 2004, *Theory of deformation in small volumes of materials*, Proceedings of the Royal Society A**460**, 2781-96.

P. Puech, H. Hubel, D.J. Dunstan, R.R. Basca, C. Laurent and W. Basca, 2004, *Discontinuous tangential stress gradient and line broadening in external and internal carbon nanotubes*, Physical Review Letters **93**, 095506.

N.B. Jayaweera, J.R. Downes, M.D. Frogley, M. Hopkinson, A.J. Bushby, P. Kidd, A. Kelly and D.J. Dunstan, 2003, *The onset of plasticity in nanoscale contact loading,* Proceedings of the Royal Society, London, A**459**, 2049-2068.

J.R Wood, Q. Zhao, M.D. Frogley, E.R. Meurs, A.D. Prins, T. Peijs, D.J. Dunstan and H.D. Wagner, 2000, *Carbon nanotubes: From molecular to macroscopic sensors*, Physical Review B**62**, 7571-7575.

D.J. Dunstan, 1997, *Strain and strain relaxation in semiconductors*, Invited Review, Journal of Materials Science: Materials in Electronics **8**, 337-375.

M.E. Brenchley, M. Hopkinson, A. Kelly, P. Kidd and D.J. Dunstan, 1997, *Coherency strain as an athermal strengthening mechanism*, Physical Review Letters **78**, 3912-3914.

R. Beanland, D.J. Dunstan and P.J. Goodhew, 1996, *Plastic relaxation and relaxed buffer layers for semiconductor epitaxy*, Advances in Physics **45**, 87-146.

W.P. Gillin, D.J. Dunstan, K.P. Homewood, L.K. Howard and B.J. Sealy, 1993, *Interdiffusion in InGaAs/GaAs quantum well structures as a function of depth*, Journal of Applied Physics **73**, 3782-3786.

D.J. Dunstan, 1989, *Theory of the gasket in diamond anvil high-pressure cells,* Review of Scientific Instruments **60**, 3789-3795.

D.J. Dunstan and W. Scherrer, 1988, *A miniature cryogenic diamond anvil high pressure cell,* Review of Scientific Instruments **59**, 627-630.

D.J. Dunstan and F. Boulitrop, 1984, *Photoluminescence in hydrogenated amorphous silicon,* Physical Review B**30**, 5945-5957.

D.J. Dunstan, 1982, *Kinetics of distant-pair recombination: I. Amorphous silicon luminescence at low temperature,* Philosophical Magazine B**46**, 579-594.

D.J. Dunstan and J.J. Davies, 1979, *The behaviour of donor-acceptor recombination emission in II-VI crystals subjected to magnetic resonance,* Journal of Physics C**12**, 2927- 2944.

Current Focus:

I have two current research programmes. One is the optical spectroscopy of carbon nanotubes under high pressure. This work is in close collaboration with Prof. A. San Miguel at the University of Lyon, France, and Dr Yiwei Sun and Prof. Colin Humphreys at QMUL.

The other is the study of plasticity in small volumes, in close collaboration with Dr A.J. Bushby at Queen Mary. Here we have identified the interaction between the grain size of metals and the volume under stress. We have identified the importance of the volume of initial plasticity, and mapped it out in nanoindentation. We are developing experiments capable of testing different forms of strain-gradient plasticity theory and of rival theories (critical thickness theory and slip-distance theory).

I work with Absolute Action Ltd. on applications of optical-fibre lighting, for museums, stately homes, etc.

Recognition and Awards

Recent **invited** presentations include

Micro-torsion experiments – International Symposium on Plasticity 2015, January 2015, Montego Bay (Jamaica)

Maximum likelihood methods applied to snails, Raman spectra, biomedical data and metallurgy – Research Seminar, Dept of Physics, University of Liverpool, February 2018

Snails, Raman spectra, biomedical data and metallurgy – Invited Lecture, COEFIS XI, Tenerife, March 2018.

Invited Professor, at CEMES/CNRS, University of Toulouse, France, March and April 2014. Also at Institut Lumière Matière, University of Lyons, France, February to July 2015, and February to July 2016.

Recent research **funding**:

EPSRC EP/C518004, 2005-10, £656,429. *Deformation of nanostructures and small volumes.*

EPSRC EP/G070539, 2009-11, £231,216. *Tunable Raman spectroscopy of carbon nanotubes under high pressure.*

Member of the European High Pressure Research Group. I have served two terms on the Committee of the Group and served on the Programme Committees and Organising Committees of several of its Annual Conferences. I organised and chaired EHPRG51, held in London in Sept 2013.

Member of the Programme Committee of the International Conference on the Physics of Semiconductors satellite conference on High Pressure in Semiconductor Physics (1996, 2004, 2006).

Sc.D. (Higher Doctorate of Science) awarded by the University of Cambridge, 2007

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