

Personal Introduction

David James DUNSTAN, M.A., Ph.D, Sc.D., F.Inst.P., C.Phys., F.R.S.A.,

Professor of Experimental Physics in the University of London.

Fellow of the Institute of Physics, London.

Fellow of the Royal Society of Arts, London.

Personal Information

Birthdate: 7th July 1952

Nationality: British

Telephone: 020 7882 3687

E-mail: d.dunstan@qmul.ac.uk

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, and plasticity in small volumes. In these areas, I have published some 250 peer-reviewed papers (no books), with an *h* index of 37 (Web of Science). I have supervised 22 research students, all awarded their PhDs.

Most Significant Papers:

1. 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 **C12**, 2927- 2944.
2. D.J. Dunstan, 1982, *Kinetics of distant-pair recombination: I. Amorphous silicon luminescence at low temperature*, Philosophical Magazine **B46**, 579-594.
3. D.J. Dunstan and F. Boulitrop, 1984, *Photoluminescence in hydrogenated amorphous silicon*, Physical Review **B30**, 5945-5957.
4. S.P. Depinna and D.J. Dunstan, 1984, *Frequency-resolved spectroscopy and its application to the analysis of recombination in semiconductors*, Philosophical Magazine **B50**, 579-597.
5. D.J. Dunstan and W. Scherrer, 1988, *A miniature cryogenic diamond anvil high pressure cell*, Review of Scientific Instruments **59**, 627-630.

6. D.J. Dunstan, 1989, *Theory of the gasket in diamond anvil high-pressure cells*, Review of Scientific Instruments **60**, 3789-3795.
7. 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.
8. 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.
9. 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.
10. D.J. Dunstan, 1997, *Strain and strain relaxation in semiconductors*, Invited Review, Journal of Materials Science: Materials in Electronics **8**, 337-375.
11. J.R. Wood, M.D. Frogley, E.R. Meurs, A.D. Prins, T. Peijls, D.J. Dunstan and H.D. Wagner, 1999, *Mechanical response of carbon nanotubes under molecular and macroscopic pressures*, Journal of Physical Chemistry B **103**, 10388-10392.
12. J.R. Wood, Q. Zhao, M.D. Frogley, E.R. Meurs, A.D. Prins, T. Peijls, D.J. Dunstan and H.D. Wagner, 2000, *Carbon nanotubes: From molecular to macroscopic sensors*, Physical Review B **62**, 7571-7575.
13. 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.
14. 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, pp. 1-4.
15. 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.
16. P. Moreau, M. Raulic, K.M.Y. P'ng, G. Gannaway, P. Anderson, W.P. Gillin, A.J. Bushby and D.J. Dunstan, 2005, *Measurement of the size effect in the yield strength of nickel foils*, Philosophical Magazine Letters **85**, 339-343.
17. T.T. Zhu, A.J. Bushby and D.J. Dunstan, 2008, *Size effect in the initiation of plasticity for ceramics in nanoindentation*, Journal of the Mechanics and Physics of Solids **56**, 1170-1185.
18. 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, pp 1-4.
19. A.J. Bushby and D.J. Dunstan, 2010, *Size effects in yield and plasticity under uniaxial and non-uniform loading: Experiment and theory*, Philosophical Magazine **91**, 1037-1049.
20. D.J. Dunstan and A.J. Bushby, 2013, *The scaling exponent in the size effect of small scale plastic deformation*, International Journal of Plasticity **40**, 152-162.

Current Focus:

I have two current research programmes. One is the optical spectroscopy of carbon nanotubes under high pressure. We are now using tunable excitation in order to track the resonances of specific tubes (identified by their radial breathing modes) with pressure, to obtain reliable pressure coefficients to help understand the solvent effects on the nanotubes. This work is in close collaboration with Prof. M.P. Halsall at Manchester University.

The other is the study of plasticity in small volumes. 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).

Recent Recognition and Awards

Recent and forthcoming **invited** presentations include

Raman studies of nanotubes under high pressure – EHPRG47, Sept 2009, Paris

Comparison of plasticity size effects in uniaxial and non-uniform loading – ECI 9BA, Oct 2009, Barga (Italy)

Size Effects at the Yield Point of Metals and Ceramics – International Symposium on Plasticity, January 2011, Puerto Vallarta (Mexico)

Size effect theories for the yield and flow stress of metals – International Symposium on Plasticity, January 2012, Puerto Rico (USA).

The Hall-Petch Effect: Another Size Effect? – International Symposium on Plasticity, January 2013, Nassau (Bahamas).

Nano-Mechanics of Carbon Nanoparticles – GAMM84, 84th annual meeting of the Gesellschaft für Angewandte Mathematik und Mechanik, March 2013, Novi Sad (Serbia).

The Size Effect: Micropillars and the Hall-Petch Effect – TMS 2013 Nanoscale Multilayers, October 2013, Madrid

The Size Effect from the Nanoscale to the Hall-Petch Effect – MS&T 2013 Symposium on Deformation and Transitions at Grain Boundaries, October 2013, Montreal

Size effect theories for the yield and flow stress of metals – International Symposium on Plasticity, January 2014, Puerto Rico (USA).

Six lectures for *Structure and Multiscale Mechanics of Carbon Nanomaterials*, CISM, July 2014, Udine (Italy).

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

DJD 23/9/2013