

Curriculum Vitae: Dr Judith Hart

Contact details

Work: School of Chemistry
University of Bristol
Bristol BS8 1TS
Phone: 0117 3318 095

Home: Second Floor
9 Caledonia Place
Bristol BS8 4DH
Phone: 07813 978 303

Qualifications

Ph.D., Monash University, Australia. Thesis title: Sol-gel and Microwave Processing of Titanium Dioxide for Dye-Sensitised Solar Cells. Supervisors: Prof. Yi-Bing Cheng, FTSE, Department of Materials Engineering; Prof. Leone Spiccia, FRACI, School of Chemistry; Prof. George Simon, Department of Materials Engineering. Enrolled: March, 2002 to December, 2005 (full-time); thesis approved: 19th December, 2006; graduation: 10th May, 2007.

The aim of my Ph.D. research was to investigate new low temperature processing techniques for nanostructured titanium dioxide films. These films are important for many applications, including dye-sensitised solar cells. It was anticipated that the application of non-conventional heating techniques may allow a reduction in the processing temperature, thus enabling the glass substrate that is currently used for these solar cells to be replaced with a flexible polymer substrate, while maintaining good solar cell efficiencies. The possibility of using microwave processing in the production of dye-sensitised solar cells was investigated, with a focus on enhancing understanding of this novel heating technique. It was found that, under certain conditions, microwave heating at low temperatures results in significantly better solar cell performance than conventional heating at the same temperature. This research included computational work in parallel with experimental work.

Bachelor of Engineering (Materials Engineering) with First Class Honours, Monash University, Australia. Enrolled: February, 1997 to November, 2001; graduation: 2nd May, 2002.

Employment History

Post-doctoral Research Assistant, School of Chemistry, University of Bristol, U.K., from 1st October, 2009.

I am currently investigating the use of diamond films for microplasma devices. This involves deposition and characterisation of diamond films, which will be tested in microplasma devices, with the aim of optimising the films to allow generation of stable plasmas at atmospheric pressure. This role includes supervision of a PhD student and communicating regularly with collaborators involved in this multi-disciplinary research. I am also using computational techniques to predict the crystal structures and properties of novel Group 14 nitrides and phosphides and using experimental techniques to test the computational predictions.

My position at the University of Bristol includes some teaching work, such as tutorials, workshops and problem solving classes (average of ~ 1 hour/week during semester).

Ramsay Memorial Fellow, School of Chemistry, University of Bristol, U.K., from 1st October, 2007, to 30th September, 2009.

My research involved a combined programme of theoretical and experimental work, with the aim of designing and fabricating new inorganic materials. Theoretical investigation of the crystal structures of carbon nitride and carbon phosphide has led to increased understanding of the chemistry of these materials, corrected results that others have published previously and helped to explain the reasons why synthesis of these materials has not, so far, been successful. This has enabled prediction of the synthesis conditions that are most likely to favour formation of the crystal structures that have the most interesting properties. This work involved a collaboration with Compagnie de Saint-Gobain, Paris.

Reason for leaving: End of research contract.

Post-doctoral Research Officer, Department of Chemical Engineering and Department of Chemistry, University of Bath, U.K., from 27th February, 2006, to 30th June, 2007; Honorary Research Assistant, from 1st July to 30th September, 2007.

The aim of my research was to investigate the use of multi-layered titanium dioxide nanotubes for hydrogen storage and sensing. This involved synthesis and characterisation of the nanotubes, as well as numerical modelling, to determine the structure of the nanotubes and the mechanisms of adsorption and transport of hydrogen.

This position also included planning and delivering problem-solving classes for first year chemical engineering students.

Reason for leaving: End of research contract.

Laboratory Demonstrator and Class Tutor, Department of Materials Engineering and Faculty of Science, Monash University, from March, 2001, to June, 2005 (part-time, average of ~ 2 hours/week during semester).

This position involved teaching in a range of settings, including demonstrating laborating activities and marking lab reports. I was also a Class Tutor for the 2nd year subject "How Science Works", which involved planning and delivering two-hour workshops.

Reason for leaving: Completed Ph.D. studies.

Inspections Department at the Shell Oil Refinery, Corio (Australia), from October, 2000, to February, 2001 (in addition to three months work experience in 1998-99).

Research Assistant/Process Improvement Engineer at Amcor Australia, from March to September, 2000.

Research Funding

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| 2011 | Beamtime at the Diamond Light Source (United Kindgom) - Awarded four days of beam time to do high pressure crystallisation studies of phosphorus carbide. Application in collaboration with Prof. Paul McMillan (University College London) and Dr. Ashkan Salamat (European Synchrotron Radiation Facility). |
| 2010 | Beamtime at the European Synchrotron Radiation Facility (ESRF) - Awarded five days of beam time to do high pressure crystallisation studies of phosphorus carbide. Application in collaboration with Prof. Paul McMillan (University College London). |
| 2008 | Royal Society Research Grant ("New routes to novel thin film materials by pulsed laser deposition"), £14050, Principal Investigator, 1st October, 2008, to 30th September, 2009. |
| 2007 | Ramsay Memorial Research Fellowship, £53778, 1st October, 2007, to 30th September, 2009. |
| 2004 | Jim O'Donnell International Travel Award from the Royal Australian Chemical Institute for attendance at an international conference, (\$1500). |
| 2003 | Sir David Zeidler Travelling Scholarship to fund extended travel, including conference attendance, laboratory visits and visits to collaborators, as part of my Ph.D. studies, (\$15000). |
| 2002 | Sir James McNeill Foundation Scholarship, a prestigious scholarship for doctoral studies at Monash University in Music, Engineering, Science or Medicine for environmentally responsible and socially beneficial research, ~ \$25000 p.a. including allowances, March, 2002, to September, 2005. |

Academic Awards

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| 2001 | Institution of Engineers, Australia, Prize and Ian Langlands Medal for "the most outstanding student completing the Bachelor of Engineering at Monash University, based on academic record, personal qualities and interest and involvement in professional and other activities". |
| 2001 | I.J. Polmear Materials Engineering Prize for "achieving the highest average mark upon completion of the Materials Engineering stream of the Bachelor of Engineering at Monash University". |
| 2001 | Institute of Materials Engineering Australasia Prize for "submitting the best report on a final year research project in materials science or engineering at a Victorian university". |

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| 2001 | Monash Vice-Chancellor's Undergraduate Research Scholarship for "outstanding academic merit and research potential". |
| 2000 | Golden Key National Honours Society Undergraduate Scholarship, based on academic excellence, breadth of work experience and involvement in the community. |
| 1999 | Orica Prize for Engineering based on "academic excellence and breadth of well-balanced, all-round achievement", awarded upon completion of level three of the Bachelor of Engineering at Monash University. |
| 1997 | Monash Engineering Industry Scholarship to support studies for the Bachelor of Engineering at Monash University, A\$10600 p.a., March, 1997 to December, 2001. |

Professional Memberships

Institute of Physics

Royal Australian Chemical Institute

Women in Science Enquiry Network (Australia)

Public Engagement Activities

2007-2011 Volunteer at At-Bristol (Bristol's Science Museum)

1998-2001 Organiser and member of staff for various science camps for high school students

1998-2001 Secretary and Vice-President of the Melbourne Chapter of the Young Scientists of Australia

Publications record

Refereed journal articles

1. J. N. Hart, P. W. May, N. L. Allan, K. R. Hallam, M. Ruda, F. Claeysens and P. J. Heard, Towards new binary compounds: Synthesis of amorphous phosphorus carbide by pulsed laser deposition, Submitted.
2. J. N. Hart, N. L. Allan and F. Claeysens, Ternary silicon germanium nitrides - A potential new class of tunable band gap materials, Submitted.
3. J. N. Hart, N. L. Allan and F. Claeysens, Predicting crystal structures *ab initio*: Group 14 nitrides and phosphides, Physical Chemistry Chemical Physics, 2010, 12 8620-8631.
4. J. N. Hart, F. Claeysens, N. L. Allan and P. W. May, Carbon nitride: *Ab initio* investigation of carbon-rich phases, Physical Review B, 2009, 80 174111.
5. J. N. Hart, S. C. Parker and A. A. Lapkin, Energy Minimization of Single-Walled Titanium Oxide Nanotubes, ACS Nano, 2009, 3 3401-3412.
6. F. Claeysens, J. N. Hart, N. L. Allan and J. M. Oliva, Solid phases of phosphorus carbide: An *ab initio* study, Physical Review B, 2009, 79 134115.
7. J. N. Hart, P. W. May, N. L. Allan, J. E. P. Dahl, S. Liu, R. M. K. Carlson and J. L. Adcock, Vibrational analysis of per-fluorinated triamantane, Chemical Physics Letters, 2008, 460 237-240.
8. J. N. Hart, Y.-B. Cheng, G. P. Simon and L. Spiccia, Alternative materials and processing techniques for optimized nanostructures in dye-sensitized solar cells, Journal of Nanoscience and Nanotechnology, 2008, 8 2230-2248.
9. J. N. Hart, L. Bourgeois, Cervini, Y.-B. Cheng, G. P. Simon and L. Spiccia, Low temperature crystallization behavior of TiO₂ derived from a sol-gel process, Journal of Sol-Gel Science and Technology, 2007, 42 107-117.
10. J. N. Hart, D. Menzies, Y.-B. Cheng, G. P. Simon and L. Spiccia, A comparison of microwave and conventional heat treatments of nanocrystalline TiO₂, Solar Energy Materials and Solar Cells, 2007, 91 6-16.

11. J. N. Hart, D. Menzies, Y.-B. Cheng, G. P. Simon and L. Spiccia, Microwave processing of TiO₂ blocking layers for dye-sensitized solar cells, *Journal of Sol-Gel Science and Technology*, 2006, 40 45-54.
12. J. N. Hart, D. Menzies, Y.-B. Cheng, G. P. Simon and L. Spiccia, TiO₂ sol-gel blocking layers for dye-sensitized solar cells, *Comptes Rendus Chimie*, 2006, 9 622-626.
13. D. B. Menzies, J. N. Hart, Y.-B. Cheng, G. P. Simon, Q. Dai, L. Spiccia, Nanostructured TiO₂ films in dye-sensitized solar cells, *International Journal of Nanoscience*, 2005, 5 785-793.
14. J. N. Hart, Y.-B. Cheng, G. P. Simon and L. Spiccia, Challenges of producing titanium dioxide films by sol-gel processing and microwave heating, *Surface and Coatings Technology*, 2005, 198 20-23.
15. J. N. Hart, R. Cervini, Y.-B. Cheng, G. P. Simon and L. Spiccia, Formation of anatase TiO₂ by microwave processing, *Solar Energy Materials and Solar Cells*, 2004, 84 135-143.
16. J. N. Hart, R. Cervini, Y.-B. Cheng, G. P. Simon and L. Spiccia, Low temperature formation of anatase titanium dioxide, *Euro Ceramics VIII*, 2004, 264-268 1221-1224.
17. L. M. Rodríguez-Lorenzo, J. N. Hart and K. A. Gross, Structural and chemical analysis of well-crystallized hydroxyfluorapatites, *Journal of Physical Chemistry B*, 2003, 107 8316-8320.
18. L. M. Rodríguez-Lorenzo, J. N. Hart and K. A. Gross, Influence of fluorine in the synthesis of apatites. Synthesis of solid solutions of hydroxy-fluorapatite, *Biomaterials*, 2003, 24 3777-3785.
19. L. M. Rodríguez-Lorenzo, J. N. Hart and K. A. Gross, Solid solutions of hydroxyfluorapatite. Influence of the amount of fluoride on mechanical properties, *Journal of the Australian Ceramic Society*, 2002, 38 154-158.
20. K. A. Gross, J. Hart and L. M. Rodríguez-Lorenzo, Fluor-hydroxyapatite solid solutions as alternative bioceramics, *Key Engineering Materials*, 2002, 218-220 165-168.

Refereed contributions to symposia¹

Oral presentations

1. *J. N. Hart*, N.L. Allan and F. Claeysens, Ternary silicon germanium nitrides - A potential new class of tunable band gap materials, 10th International Conference on Materials Chemistry, Manchester, United Kingdom, July, 2011.
2. *J. N. Hart*, N.L. Allan, F. Claeysens, P. W. May and M. Ruda, Prediction of crystal structures and properties of Group 14 nitrides and phosphides, 3rd International Symposium on Structure-Property Relationships in Solid State Materials, Stuttgart, Germany, June/July, 2010.
3. *J. N. Hart*, S. C. Parker and A. A. Lapkin, Titanium oxide nanotubes - Crystal structure investigation by energy minimisation, RSC Solid State Group Meeting, London, U.K., April, 2008.
4. *J. N. Hart*, Y.-B. Cheng, G. P. Simon and L. Spiccia, Microwave heating of TiO₂ blocking layers for dye-sensitized solar cells, 6th Pacific Rim Conference on Ceramic and Glass Technology, Kapalua, Hawaii, USA, September, 2005.
5. *J. N. Hart*, Y.-B. Cheng, G. P. Simon and L. Spiccia, Microwave heating of TiO₂ films for dye-sensitized solar cells, AustCeram - Australasian Ceramic Society Conference, Melbourne, Australia, November/December, 2004.
6. *J. N. Hart*, Y.-B. Cheng, G. P. Simon and L. Spiccia, Challenges of producing titanium dioxide films by sol-gel processing and microwave heating, Thin Films 2004 - 2nd International Conference on Technological Advances of Thin Films and Surface Coatings, Singapore, July, 2004.
7. *D. B. Menzies*, J. N. Hart, Y.-B. Cheng, G. P. Simon and L. Spiccia, Nanostructured TiO₂ films in dye-sensitised solar cells, NanoTech 2004 - 1st International Conference on Nanotechnology, Singapore, July, 2004.

¹The presenting author is emphasised.

8. *J. N. Hart*, Y.-B. Cheng, G. P. Simon and L. Spiccia, A comparison of microwave and conventional heat treatment of nanocrystalline titanium dioxide, Destination Renewables - from Research to Market, 41st Annual Conference of the Australian and New Zealand Solar Energy Society, Melbourne, Australia, November, 2003.
9. *J. N. Hart*, R. Cervini, Y.-B. Cheng, G. P. Simon and L. Spiccia, Low temperature formation of anatase titanium dioxide, European Ceramic Society Conference, Istanbul, Turkey, June/July, 2003.
10. *J. N. Hart*, R. Cervini, Y.-B. Cheng, G. P. Simon and L. Spiccia, Formation of anatase titanium dioxide by low temperature and microwave processing, International Solar Energy Society Solar World Congress, Göteborg, Sweden, June, 2003.
11. *L. M. Rodríguez-Lorenzo*, J. N. Hart and K. A. Gross, Solid solutions of hydroxyfluorapatite. Influence of the amount of fluorine in sintering ability and mechanical properties, AustCeram - Australasian Ceramic Society Conference, Perth, Australia, September/October, 2002.
12. K. A. Gross, *J. Hart* and L. M. Rodríguez-Lorenzo, Fluor-hydroxyapatite solid solutions as alternative bioceramics, 14th International Symposium on Ceramics in Medicine (Bioceramics 14), Palm Springs, California, USA, November, 2001.

Posters

1. *J. N. Hart*, F. Claeysens, N.L. Allan and P. W. May, Carbon nitride crystal structures: An *ab initio* investigation of carbon-rich phases, 12th European Conference on Solid-State Chemistry, Münster, Germany, September, 2009.
2. J. N. Hart, D. Menzies, Y.-B. Cheng, G. P. Simon and L. Spiccia, TiO₂ sol-gel blocking layers for dye-sensitized solar cells, 15th International Conference on Photochemical Conversion and Storage of Solar Energy, Paris, France, July, 2004.

Popular science

1. J. Hart, Dye-sensitized solar cells - the future of photovoltaics? CSIRO Sustainability Network Newsletter, December 2003, Update 35, 1-6 (invited article, available at www.bml.csiro.au/SNnewsletters.htm).