Dr Richard F. Webster

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***h*-index**:	**Number of Publications**:	**Average SJR:**
8	27	3.13
Number of Citations:	**Citations Per Publication**:	**Average SNIP**:
234	8.6	1.61

Research Interests

My interests lie in the application and development of novel electron microscopy methods to determine chemical composition, crystal structure and defect nature of materials, especially at interfaces, in order to discover underpinning relationships between the micro- and nano- structure and physical properties of materials.
Recent work has included:

- characterisation of STO/LAO interfaces to quantify the atomic and elemental nature of these intefaces and relating these to the electrical properties of a 2d electron gas (2DEG) formed at the interface.
- compositional profiling using EDX of $In_xGa_{1-x}N$ nanorods, this work has lead to a model describing the growth of teriary III-nitride nanorods grown by MBE.
- chemical mapping of Pd–Ru core–shell nanoparicles to determine shell thicknesses <1 nm for enhanced OER stability.

Employment

University of New South Wales, *Electron Microscope Unit*

Research Associate *Jan 2017 – present*

- *Summary:* My main role in the electron microscope unit is to manage the JEOL F200 analytical STEM, installed in 2017. In this role I am involved with the publication of high impact research, training new users, routine maintence and ensuring that the microscope performs as well as it should and meets target KPIs.
- *Additional roles:* Whilst working at UNSW I have been involved in the preparation of a successful business case to the University for the purchase of an aberration corrected TEM and the subsequent application for federal funding, the recruitment of a deputy director, the monitoring of electromagnetic fields across the EMU, I was involved in the design of a new laboratory for the installation of an double corrected AC-TEM at UNSW. I was awarded an internal grant for an in-situ holder and was lead the subsequent procurement process. I have been involved at all stages of the procurement of a new AC-TEM at UNSW. I have also designed and run practical TEM sessions for undergraduate teaching courses for CHEM 3rd and 4th yrs and have assisted in writing the HRTEM section of the Microscopy Australia MyScope online teaching module. I was trained to use the AC-TEM at USyd and have acted as liaison for users at UNSW wishing to take samples to use this instrumentation.

University of Bristol, *H.H. Wills Physics Laboratory*

Research Associate *Nov 2015 – Dec 2016*

- *Summary*: To study the growth of GaN films grown on polycrystalline diamond to utilise its high thermal conductivity and improve the reliability of HEMT and LED devices. This work mainly used TEM and related methods. This work included the dislocation analysis of III-N films grown directly on diamond and with a novel epitaxial layer overgrowth method and the effect of AlN thickness on thermal boundary resistance.

- *Additional roles*: Sample preparation using FIB/SEM and mechanical polishing. Work on external industrial contracts. Routine TEM maintenance including filament replacement, microscope alignment and consulting service engineers when necessary. Training new TEM users including data analysis.

EDUCATION

University of Bristol, *H.H. Wills Physics Laboratory*

Ph.D. Physics *Sept 2011 – Sept 2015*

- *Thesis*: 'Transmission Electron Microscopy of Indium Gallium Nitride Nanorods'
- *Supervisor*: Professor David Cherns
- *Summary*: $In_xGa_{1-x}N$ nanorods were grown on silicon substrates grown using molecular beam epitaxy (MBE) at Nottingham University for solar cell applications. The focus of my Ph.D. thesis was the characterisation of the structure and composition of these nanorods. This was primarily achieved using electron microscopy techniques. The main findings of this work includes:
  - the demonstration that $In_xGa_{1-x}N$ nanorods spontaneously grow with a core-shell structure. Energy dispersive X-ray (EDX) spectroscopy was used to show that the cores are significantly more In-rich than the shells and to map the composition,
  - direct observation of spinodal decomposition within the $In_xGa_{1-x}N$ nanorod cores using EDX mapping and high angle annular dark field STEM imaging and
  - devising a model to predict the vertical and lateral growth rates of $In_xGa_{1-x}N$ nanorods for a given growth temperature and composition.

  Additional research included an electron diffraction and HRTEM study of a novel defect structure in tungsten oxide nanorods, dislocation analysis of gallium nitride films and characterisation of tin disulphide thin films.

University of Bristol, *H.H. Wills Physics Laboratory*

MSci (Hons) Physics, (2:1) *Oct 2007 – Jul 2011*

- *Dissertation*: 'Monolithic Active Pixel Sensors (MAPS)'
- *Supervisor*: Professor Joel Goldstein
- *Summary*: The response of a monolithic active pixel sensor to incident X-rays from a Fe-55 source was characterised. This detector was to be used as a vertex tracker in a particle detector such as the LHC.
- *Relevant courses*: Condensed Matter Physics, Mathematical Methods, Modern Optics, Nanoscience, Particle Physics, Quantum Mechanics, Soft Condensed Matter Physics.

SKILLS

Electron Microscopy

- 7 years experience using transmission electron microscopy techniques, including: dark field electron microscopy, electron diffraction: selected area and convergent beam (CBED) techniques, energy dispersive x-ray spectroscopy (EDX), high resolution electron microscopy (HRTEM) and high angle annular dark field (HAADF) STEM
- Aberration Corrected TEM experience ona Thermo Fisher Themis Z double corrected TEM
- Routine TEM maintenance: filament replacement, microscope alignment, film development and liaising with service engineers
- TEM sample preparation techniques including drop-casting, mechanical polishing, argon ion polishing and focused ion beam (FIB)
- SEM imaging and alignment

Computing

- Programming languages: Python
- Typesetting: LaTeX and HTML
- Software: Digital Micrograph, ImageJ, Inkscape
- Operating systems: Linux (Fedora and Ubuntu) and Windows

Teaching

- Practical TEM sessions for UNSW courses CHEM3061 and CHEM4601
- 3 years of teaching in an undergraduate laboratory environment: demonstrating 1st and 2nd year experiments and teaching in group tutorial sessions
- 4 years experience in training new users and students in the use of TEMs and associated data analysis
- Preparation and delivery of a lecture series “Introduction to TEM” run for EMU users

Financial Awards

- $250,000 (AUD) – UNSW Research Infrastructure Scheme, Oct 2018
- $500 (AUD) – Australian Microscopy & Microanalysis Society (AMMS) Conference Bursary, Sept 2018
- UK Nitrides Consortium (UKNC) Travel Bursary, Sept 2013

Professional Memberships

- Australian Microscopy & Microanalysis Society (AMMS)
- Royal Microscopy Society (RMS)
- European Microscopy Society (EMS)

Publication List

Ph.D. Thesis

1. R. F. Webster, “Transmission Electron Microscopy of Indium Gallium Nitride Nanorods”, PhD thesis (University of Bristol, 2015).

Research Articles

1. C. Ledermueller, H. I. Pratiwi, R. F. Webster, M. Eizadjou, S. P. Ringer, and S. Primig, “Microalloying effects of Mo versus Cr in HSLA steels with ultrafine-grained ferrite microstructures”, Materials & Design **185**, 108278 (2020).
2. S. S. Mofarah, E. Adabifiroozjaei, Y. Wang, R. Pardehkhorram, Y. Yao, M. H. N. Assadi, R. Mehmood, W.-F. Chen, C. Tsounis, J. Scott, et al., “Assembly of Cerium-Based Coordination Polymer into Variant Polycrystalline 2D-3D CeO 2-x Nanostructures”, Journal of Materials Chemistry A (2020).
3. E. Adabifiroozjaei, P. Koshy, F. Emadi, S. S. Mofarah, H. Ma, E. Rastkerdar, S. Lim, R. F. Webster, D. R. Mitchell, and C. C. Sorrell, “Ionic Interdiffusion as Interaction Mechanism between Al and Si3N4”, Journal of the American Ceramic Society **102**, 4835–4847 (2019).
4. A. Alinezhad, L. Gloag, T. M. Benedetti, S. Cheong, R. F. Webster, M. Roelsgaard, B. B. Iversen, W. Schuhmann, J. J. Gooding, and R. D. Tilley, “Direct growth of highly strained Pt islands on branched Ni nanoparticles for improved hydrogen evolution reaction activity”, Journal of the American Chemical Society **141**, 16202–16207 (2019).
5. H. Deng, Y. Zeng, M. Ishaq, S. Yuan, H. Zhang, X. Yang, M. Hou, U. Farooq, J. Huang, K. Sun, et al., “Quasiepitaxy Strategy for Efficient Full-Inorganic Sb2S3 Solar Cells”, Advanced Functional Materials **29**, 1901720 (2019).
6. P. S. M. Gharavia, L. Xie, R. F. Webster, C. K. Y. Park, Y. H. Ng, J. He, J. N. Hart, and N. Valanoor, “Interfacial origins of visible-light photocatalytic activity in ZnS–GaP multilayers”, Acta Materia **181**, 139–147 (2019).
7. C. Ledermueller, E. Kozeschnik, R. F. Webster, and S. Primig, “Advanced Thermo-mechanical Process for Homogenous Hierarchical Microstructures in HSLA Steels”, Metallurgical and Materials Transactions A **50**, 5800–5815 (2019).
8. S. S. Mofarah, E. Adabifiroozjaei, Y. Yao, P. Koshy, S. Lim, R. Webster, X. Liu, R. K. Nekouei, C. Cazorla, Z. Liu, et al., “Proton-assisted creation of controllable volumetric oxygen vacancies in ultrathin CeO2-x for pseudocapacitive energy storage applications”, Nature Communications **10**, 2594 (2019).

9. A. D. Pogrebnjak, C.-H. Kong, R. F. Webster, R. Tilley, Y. Takeda, K. Oyoshi, O. V. Bondar, V. Buranich, S. Konstantinov, L. Baimoldanova, et al., “Antibacterial effect of Au implantation in ductile nanocomposite multilayer (TiAlSiY) N/CrN coatings”, ACS applied materials & interfaces (2019).
10. W. O. Silva, G. C. Silva, R. F. Webster, T. M. Benedetti, R. D. Tilley, and E. A. Ticianelli, “Electrochemical reduction of CO2 on N-doped carbon catalysts with and without iron”, ChemElectroChem (2019).
11. J. Wu, M. Fenech, R. F. Webster, R. D. Tilley, and N. Sharma, “Electron microscopy and its role in advanced lithium-ion battery research”, Sustainable Energy & Fuels **3**, 1623–1646 (2019).
12. Q. Zhang, R. F. Webster, S. Cheong, R. D. Tilley, X. Lu, and R. Amal, “Ultrathin Fe-N-C Nanosheets Coordinated Fe-Doped CoNi Alloy Nanoparticles for Electrochemical Water Splitting”, Particle & Particle Systems Characterization **36**, 1800252 (2019).
13. S. C. Binding, I. Pernik, V. R. Gonçales, C. M. Wong, R. F. Webster, S. Cheong, R. D. Tilley, A. E. Garcia-Bennett, J. J. Gooding, and B. A. Messerle, “Simultaneous Functionalization of Carbon Surfaces with Rhodium and Iridium Organometallic Complexes: Hybrid Bimetallic Catalysts for Hydroamination”, Organometallics **38**, 780–787 (2018).
14. S. F. U. Farhad, R. F. Webster, and D. Cherns, “Electron microscopy and diffraction studies of pulsed laser deposited cuprous oxide thin films grown at low substrate temperatures”, Materialia **3**, 230–238 (2018).
15. L. Gloag, T. M. Benedetti, S. Cheong, R. F. Webster, C. E. Marjo, J. J. Gooding, and R. D. Tilley, “Pd–Ru core–shell nanoparticles with tunable shell thickness for active and stable oxygen evolution performance”, Nanoscale **10**, 15173–15177 (2018).
16. H. Hu, A. Pham, R. D. Tilley, R. Zeng, T. T. Tan, C.-H. Kong, R. Webster, D. Wang, and S. Li, “Largely Enhanced Mobility in Tri-Layered LaAlO3/SrTiO3/LaAlO3 Heterostructures”, Appl. Mater. Interfaces (2018).
17. Q. Y. Soundararajah, R. F. Webster, I. J. Griffiths, S. V. Novikov, C. T. Foxon, and D. Cherns, “Composition and strain relaxation of In x Ga 1-x N graded core shell-nanorods”, Nanotechnology **29**, 405706 (2018).
18. A. Pooth, J. Bergsten, N. Rorsman, H. Hirshy, R. Perks, P. Tasker, T. Martin, R. Webster, D. Cherns, M. J. Uren, et al., “Morphological and electrical comparison of Ti and Ta based ohmic contacts for AlGaN/GaN-on-SiC HFETs”, Microelectronics Reliability **68**, 2–4 (2017).
19. L. A. Burton, T. Whittles, D. Hesp, W. M. Linhart, J. M. Skelton, B. Hou, R. Webster, G. O’Dowd, R. Christian, D. Cherns, et al., “Electronic and optical properties of single crystal SnS2: an earth-abundant disulfide photocatalyst.”, Journal of Materials Chemistry A (2015).
20. R. F. Webster, D. Cherns, M. Kuball, Q. Jiang, and D. Allsopp, “Electron microscopy of gallium nitride growth on polycrystalline diamond”, Semiconductor Science and Technology **30**, 114007 (2015).
21. R. Webster, Q. Soundararajah, I. Griffiths, D. Cherns, S. Novikov, and C. Foxon, “Microstructure of In x Ga 1- x N nanorods grown by molecular beam epitaxy”, Semiconductor Science and Technology **30**, 114014 (2015).
22. D. Cherns, R. Webster, S. Novikov, C. T. Foxon, A. Fischer, F. Ponce, and S. Haigh, “Compositional variations in In0. 5Ga0. 5N nanorods grown by molecular beam epitaxy”, Nanotechnology **25**, 215705 (2014).
23. L. Goff, R. Powell, A. Kent, C. Foxon, S. Novikov, R. Webster, and D. Cherns, “Molecular beam epitaxy of InN nanorods on Si-and C-faces of SiC substrates”, Journal of Crystal Growth **386**, 135–138 (2014).
24. B. Hou, D. Benito-Alifonso, R. Webster, D. Cherns, M. C. Galan, and D. J. Fermın, “Rapid phosphine-free synthesis of CdSe quantum dots: promoting the generation of Se precursors using a radical initiator”, Journal of Materials Chemistry A **2**, 6879–6886 (2014).
25. P. Huang, M. M. A. Kalyar, R. F. Webster, D. Cherns, and M. N. Ashfold, “Tungsten oxide nanorod growth by pulsed laser deposition: influence of substrate and process conditions”, Nanoscale **6**, 13586–13597 (2014).

26. D. Cherns, R. Webster, S. Novikov, C. Foxon, A. Fischer, and F. Ponce, “The growth of In0.5Ga0.5N and InN layers on (111) Si using nanorod intermediate arrays”, Journal of Crystal Growth **384**, 55–60 (2013).

Conference Proceedings

1. R. F. Webster, D. Cherns, S. V. Novikov, and C. T. Foxon, “Transmission electron microscopy of indium gallium nitride nanorods grown by molecular beam epitaxy”, physica status solidi (c) **11**, 417–420 (2014).
2. R. Webster, D. Cherns, L. Goff, S. Novikov, C. Foxon, A. Fischer, and F. Ponce, “Indium Nitride and Indium Gallium Nitride layers grown on nanorods”, in Journal of Physics: Conference Series, Vol. 471, 1 (IOP Publishing, 2013), p. 012025.