

# Prof. GARETH HINDS FNACE FICorr FIMMM FREng

## CURRICULUM VITAE

### Personal

Date of birth: 11th August 1973  
Address: Electrochemistry Group, National Physical Laboratory,  
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### Employment

2002 – Present National Physical Laboratory, Teddington, UK.  
Currently NPL Fellow/Science Area Leader - Electrochemistry  
2000 – 2002 Physics Department, Trinity College, Dublin 2, Ireland.  
Role: Postdoctoral Research Fellow (Electrochemistry)

### Education

1996 - 2000 Physics Department, Trinity College Dublin, Ireland.  
PhD (Electrochemistry)  
1992 - 1996 Physics Department, Trinity College Dublin, Ireland.  
B.A. (Mod) Experimental Physics

### External Positions

- President, Institute of Corrosion, Northampton, UK (2018-20)
- Honorary Professor, Electrochemical Metrology, Dept. Chemical Engineering, UCL
- Visiting Professor, Dept. Chemical & Process Engineering, U. Strathclyde
- Guest Professor, Harbin Institute of Technology, China

### Awards

- Christian Friedrich Schönbein Medal (2013) from European Fuel Cell Forum
- Rutherford Prize (2014) from NPL
- Fellow Honor (2017) from the National Association of Corrosion Engineers
- Collaborate to Innovate Award (2017) from The Engineer

### Professional societies

- Fellow of the Royal Academy of Engineering (FREng)
- Fellow of the Institute of Corrosion (FICorr)
- Fellow of the Institute of Materials, Minerals & Mining (FIMMM)

### Committees

- IEC TC 105 (Fuel Cell Technologies); IEC TC 21 (Secondary Cells and Batteries)
- NACE STG 31 (Oil and Gas Production - Corrosion and Scale Inhibition)
- NACE TG 494 (Four-point bend test), TG 533 (Underdeposit corrosion)
- EFC WP 13 (Corrosion in Oil and Gas Production)
- Member, Board of Administrators, European Federation of Corrosion
- IOM3 Corrosion Committee/Energy Transition Group; UK Corrosion Network
- Advisory Board Member: EPSRC SUPERGEN Programme, Fuel Cells/Hydrogen CDT
- BEIS Energy Storage Health & Safety Governance Group

### **Publications (see Appendix)**

- Over 200 publications, including 92 peer-reviewed journal papers, 22 conference papers, 69 NPL technical reports and numerous articles and good practice guides.
- Significant contributor to several NACE, ISO and IEC standards.

### **Invited lectures (selected)**

- *Influence of microporous layer on corrosion of PEMFC metallic bipolar plates*, AEM 2018, University of Surrey, Guildford, September 2018 (keynote).
- *Influence of surface condition on environment assisted cracking of corrosion resistant alloys*, Corrosion 16, Vancouver, Canada, March 2016.
- *Underdeposit corrosion in oil and gas applications*, Gordon Conference (Aqueous Corrosion), New London, New Hampshire, July 2014.
- *In situ mapping of electrode potential in a PEMFC*, 224<sup>th</sup> Electrochemical Society Meeting, San Francisco, October 2013.

### **Research focus**

- Development of novel in situ diagnostic techniques, modelling tools and standard test methods for assessment of corrosion and material degradation in energy applications.
- Strong track record of delivering innovative solutions to engineering problems with demonstrable impact on industry in a range of sectors, including oil and gas, power generation and electrochemical energy conversion and storage.
- Research output not only recognised for its high quality but has often challenged popular misconceptions in the scientific and technical literature, leading to significant changes in both scientific thinking and industry practice.

### **Primary scientific achievements**

- Developed coupled multi-electrode array test method for evaluation of inhibitors for underdeposit corrosion of carbon steel pipelines. Using the technique, demonstrated that operational responses to common problems in the field were often misguided due to the counter-intuitive nature of the corrosion mechanism.
- Invented method for measurement of pitting potential of corrosion resistant alloys in representative oilfield environments (elevated temperature/pressure, CO<sub>2</sub>/H<sub>2</sub>S, concentrated salt solution), using cooling rather than dilution to prevent crevice corrosion. This opens up the possibility for the development of a more scientific and cost effective framework for materials selection.
- Developed advanced drop evaporation test method for corrosion resistant alloys, showing that cracking of duplex stainless steel is possible at significantly lower temperatures than previously assumed. Led to revision of standards regarding threshold temperature for coating of these materials in marine environments.
- Performed world first in situ measurements of crack tip potential in steam turbine disc steel in condensate environment, demonstrating that only limited polarisation of the crack tip is achievable under these conditions.
- Developed innovative fuel cell reference electrode, facilitating for the first time mapping of electrode potential across the active area of an operating PEMFC. Powerful tool for evaluation of start-up/shut-down tolerant catalysts and mitigation strategies for carbon corrosion. Significant global uptake by industry.

- Invented novel galvanostatic technique for simultaneous in situ measurement of electrochemical active surface area of each cell in a PEMFC stack. This ground breaking diagnostic tool enables monitoring of catalyst degradation throughout the lifetime of a fuel cell stack, which was not previously possible.
- Pioneering in situ measurement of corrosion potential of metallic bipolar plate in an operating PEMFC, which challenged popular misconceptions on ex situ testing and will result in redefinition of US DoE test protocols and acceptance criteria.
- Application of novel reference electrode concept to PEM electrolyzers, demonstrating that catalyst degradation during shut-down is actually associated with the cathode, contrary to accepted wisdom in the industry. This is supporting the development of accelerated stress test protocols for more durable catalysts.
- Conducted world first in situ synchrotron imaging of internal structural dynamics of lithium ion battery during thermal runaway, revealing decomposition of electrolyte, gas pocket formation and collapse of electrode layers.
- Undertook the first rigorous quantitative analysis of the relative magnitude of the forces acting in aqueous solution during electrochemical reactions in an applied magnetic field, thereby demonstrating that the effect of the widely accepted paramagnetic gradient force is in fact completely negligible.

### **Consultancy**

Research, testing, failure analysis and expert advice on corrosion and material degradation for a wide range of clients, primarily in the energy sector. Selected examples are shown below - a full list of technical reports is found in the Appendix.

- Development of test methods for characterisation of localised corrosion and stress corrosion cracking of chain steels in mining environments. Client: mining contractor - NPL Test Report 2015040036 (2016).
- Evaluation of proprietary mitigation strategies for carbon corrosion during fuel cell start-up/shut-down using unique NPL instrumented cell. Client: fuel cell manufacturer - NPL Report MAT (RES) 224 (2014).
- Development of novel corrosion and wear corrosion test protocols for engine lubricants exposed to acidic combustion products. Client: lubricant manufacturer - NPL Test Report 2013060320 (2014).
- Evaluation of risk of stress corrosion cracking of carbon steel coupled to stainless steel in simulated syngas environments. Client: oil and gas operator - NPL Report MAT (RES) 208 (2013).
- Investigation and explanation of effect of cathodic protection on seawater chemistry within a wind turbine monopile. Client: wind farm operator - NPL Report MAT (RES) 193 (2013).
- Pitting potential measurements on duplex stainless steel welds at elevated temperatures and pressures not achievable by other research/testing providers. Client: oil and gas operator - NPL Test Report 2012050472 (2012).
- Evaluation of risk of underdeposit corrosion in an operational oil pipeline following failure of pig launchers. Client: oil and gas operator - NPL Test Report 2011050400 (2012).
- Evaluation of risk of galvanic corrosion of stainless steel radioactive source containers for biomedical applications. Client: radioactive source manufacturer - NPL Test Report E08010475 (2008).

## APPENDIX - PUBLICATION LIST

### Peer-reviewed journal papers

- [92] *Mass transport in PEM water electrolyzers: A review*, M. Maier, K. Smith, J. Dodwell, G. Hinds, P.R. Shearing, D.J.L. Brett, *Int. J. Hydrogen Energy* (in press)
- [91] *Electro-thermal mapping of polymer electrolyte membrane fuel cells with a fractal flow-field*, V.S. Bethapudi, J. Hack, G. Hinds, P.R. Shearing, D.J.L. Brett, M.-O. Coppens, *Energy Conversion and Management* 250, 114924 (2021)
- [90] *Improved operando Raman cell configuration for commercially-sourced electrodes in alkali-ion batteries*, T.E. Rosser, E.J.F. Dickinson, R. Raccichini, K. Hunter, A.D. Searle, C.M. Kavanagh, P.J. Curran, G. Hinds, J. Park, A.J. Wain, *J. Electrochem. Soc.* 168, 070541 (2021)
- [89] *Open-circuit dissolution of platinum from the cathode in polymer electrolyte membrane water electrolyzers*, J. Dodwell, M. Maier, J. Majasan, R. Jervis, L. Castanheira, P. Shearing, G. Hinds, D.J.L. Brett, *J. Power Sources* 498, 229937 (2021)
- [88] *Prevention of lithium-ion battery thermal runaway using polymer-substrate current collectors*, M.T.M. Pham, J.J. Darst, W.Q. Walker, T.M.M. Heenan, D. Patel, F. Iacoviello, A. Rack, M.P. Olbinado, G. Hinds, D.J.L. Brett, E. Darcy, D.P. Finegan, P.R. Shearing, *Cell Reports Physical Science* 100360 (2021)
- [87] *Acoustic time-of-flight imaging of polymer electrolyte membrane water electrolyzers to probe internal structure and flow characteristics*, M. Maier, R.E. Owen, M.T.M. Pham, J. Dodwell, J. Majasan, J.B. Robinson, G. Hinds, P.R. Shearing, D.J.L. Brett, *Int. J. Hydrogen Energy* 46, 11523 (2021)
- [86] *Influence of H<sub>2</sub>S on the pitting corrosion of 316L stainless steel in oilfield brine*, J. Hesketh, E.J.F. Dickinson, M.L. Martin, G. Hinds, A. Turnbull, *Corros. Sci.* 182, 109265 (2021)
- [85] *Acoustic emission analysis of polymer electrolyte membrane fuel cells*, V.S. Bethapudi, G. Hinds, P.R. Shearing, D.J.L. Brett, M.-O. Coppens, *ECS Trans.* 98, 177 (2020)
- [84] *Microstructural evolution of battery electrodes during calendaring*, X. Lu, S.R. Daemi, A. Bertei, M.D.R. Kok, K.B. O'Regan, L. Rasha, J. Park, G. Hinds, E. Kendrick, D.J.L. Brett, P.R. Shearing, *Joule* 4, 2746 (2020)
- [83] *Diagnosing stagnant gas bubbles in a polymer electrolyte membrane water electrolyser using acoustic emission*, M. Maier, Q. Meyer, J. Majasan, R.E. Owen, J.B. Robinson, J. Dodwell, Y. Wu, L. Castanheira, G. Hinds, P.R. Shearing, D.J.L. Brett, *Front. Energy Res.* 8, 268 (2020)

- [82] *Operando characterisation of the impact of carbon monoxide on PEMFC performance using isotopic labelling and gas analysis*, H. Becker, T. Bacquart, M. Perkins, N. Moore, J. Ihonen, G. Hinds, G. Smith, *J. Power Sources Advances* 6, 100036 (2020)
- [81] *Identifying defects in Li-ion cells using ultrasound acoustic measurements*, J.B. Robinson, R.E. Owen, M.D.R. Kok, M. Maier, J. Majasan, M. Braglia, R. Stocker, T. Amietszajew, A.J. Roberts, R. Bhagat, D. Billsson, J.Z. Olson, J. Park, G. Hinds, A.A. Tidblad, D.J.L. Brett, P.R. Shearing, *J. Electrochem. Soc.* 167, 120530 (2020)
- [80] *Application of electrochemical impedance spectroscopy to commercial Li-ion cells: A review*, N. Meddings, M. Heinrich, F. Overney, J.-S. Lee, V. Ruiz, E. Napolitano, S. Seitz, G. Hinds, R. Raccichini, M. Gaberšček, J. Park, *J. Power Sources* 480, 228742 (2020)
- [79] *Correlative acoustic time-of-flight spectroscopy and X-ray imaging to investigate gas-induced delamination in lithium-ion pouch cells during thermal runaway*, M.T.M. Pham, J.J. Darst, D.P. Finegan, J.B. Robinson, T.M.M. Heenan, M.D.R. Kok, F. Iacoviello, R. Owen, W.Q. Walker, O.V. Magdysyuk, T. Connolly, E. Darcy, G. Hinds, D.J.L. Brett, P.R. Shearing, *J. Power Sources*, 228039 (2020)
- [78] *Hydration state diagnosis in fractal flow-field based polymer electrolyte membrane fuel cells using acoustic emission analysis*, V.S. Bethapudi, J. Hack, P. Trogadas, G. Hinds, P.R. Shearing, D.J.L. Brett, M.-O. Coppens, *Energy Conversion and Management* 220, 113083 (2020)
- [77] *3D microstructure design of lithium-ion battery electrodes assisted by X-ray nano-computed tomography and modelling*, X. Lu, A. Bertej, D.P. Finegan, C. Tan, S.R. Daemi, J.S. Weaving, K.B. O'Regan, T.M.M. Heenan, G. Hinds, E. Kendrick, D.J.L. Brett, P.R. Shearing, *Nat. Commun.* 11, 1-13 (2020)
- [76] *Mass transport in polymer electrolyte membrane water electrolyser liquid-gas diffusion layers: A combined neutron imaging and X-ray computed tomography study*, M. Maier, J. Dodwell, R. Ziesche, C. Tan, T. Heenan, J. Majasan, N. Kardjilov, H. Markotter, I. Manke, L. Castanheira, G. Hinds, P.R. Shearing, D.J.L. Brett, *J. Power Sources* 455, 227968 (2020)
- [75] *Local measurement of current collector potential in a polymer electrolyte membrane water electrolyser*, H. Becker, L. Castanheira, G. Hinds, *J. Power Sources* 448, 227563 (2020)
- [74] *Acoustic emission as a function of polarisation: Diagnosis of polymer electrolyte fuel cell hydration state*, V.S. Bethapudi, M. Maier, G. Hinds, P.R. Shearing, D.J.L. Brett, M.-O. Coppens, *Electrochem. Commun.* 109, 106582 (2019)

[73] *A lung-inspired printed circuit board polymer electrolyte fuel cell*, V.S. Bethapudi, J. Hack, P. Trogadas, J.I.S. Cho, L. Rash, G. Hinds, P.R. Shearing, D.J.L. Brett, M.-O. Coppens, *Energy Conversion and Management* 202, 112198 (2019)

[72] *In situ monitoring of lithium-ion battery degradation using an electrochemical model*, C. Lyu, Y. Song, J. Zheng, W. Luo, G. Hinds, J. Li, L. Wang, *Applied Energy* 250, 685-696 (2019)

[71] *Operando flow regime diagnosis using acoustic emission in a polymer electrolyte membrane water electrolyser*, M. Maier, Q. Meyer, J. Majasan, C. Tan, I. Dedigama, J. Robinson, J. Dodwell, Y. Wu, L. Castanheira, G. Hinds, P.R. Shearing, D.J.L. Brett, *J. Power Sources* 424, 138-149 (2019)

[70] *The Butler-Volmer Equation for Polymer Electrolyte Membrane Fuel Cell (PEMFC) electrode kinetics: a critical discussion*, E.J.F Dickinson, G. Hinds, *J. Electrochem. Soc.* 166, F221-F231 (2019)

[69] *Sour testing of 316L stainless steel: Comparison of four-point bend and uniaxial tensile test methods*, J. Hesketh, A. Turnbull, G. Hinds, *Corrosion* 75, 779-789 (2019)

[68] *Influence of microporous layer on corrosion of metallic bipolar plates in fuel cells*, L. Castanheira, M. Bedouet, A. Kucernak, G. Hinds, *J. Power Sources* 418, 147-151 (2019)

[67] *Critical review of the use of reference electrodes in Li-ion batteries: a diagnostic perspective*, R. Raccichini, M. Amores, G. Hinds, *Batteries* 5, 12 (2019)

[66] *In operando measurement of localised cathode potential to mitigate DMFC temporary degradation*, C. Rabissi, E. Brightman, G. Hinds, A. Casalegno, *Int. J. Hydrogen Energy* 43, 9797-9802 (2018)

[65] *Localised electrochemical impedance measurements of a polymer electrolyte fuel cell using a reference electrode array to give cathode-specific measurements and examine membrane hydration dynamics*, E. Engebretsen, G. Hinds, Q. Meyer, T. Mason, E. Brightman, L. Castanheira, P.R. Shearing, D.J.L. Brett, *J. Power Sources* 382, 38-44 (2018)

[64] *Effect of pigging damage on sulphide stress corrosion cracking of 316L stainless steel cladding*, J. Hesketh, G. Hinds, R. Morana, *Corrosion* 74, 487-495 (2018)

[63] *Identifying the cause of rupture of lithium-ion batteries via ultra-high-speed X-ray imaging*, D.P. Finegan, E. Darcy, M. Keyser, B. Tjaden, T. Heenan, R. Jervis, J. Bailey, R. Malik, N. Vo, O. Magdysyuk, M. Drakopoulos, M. DiMichiel, A. Rack, G. Hinds, D.J.L. Brett, P.R. Shearing, *Adv. Sci.* 5, 1700369 (2018)

[62] *In situ diagnostics for polymer electrolyte membrane fuel cells*, G. Hinds, *Current Opinion in Electrochemistry* 5, 11-19 (2018)

- [61] *Tracking internal temperature and structural dynamics during nail penetration of lithium-ion cells*, D.P. Finegan, B. Tjaden, T. Heenan, R. Jervis, M. Di Michiel, A. Rack, G. Hinds, D.J.L. Brett, P.R. Shearing, *J. Electrochem. Soc.* 164, A1-A7 (2017)
- [60] *Characterising thermal runaway by inducing and monitoring internal short circuits within lithium-ion cells*, D.P. Finegan, E. Darcy, M. Keyser, B. Tjaden, T. Heenan, R. Jervis, J. Bailey, R. Malik, N. Vo, O. Magdysyuk, R. Atwood, M. Drakopoulos, M. DiMichiel, A. Rack, G. Hinds, D.J.L. Brett, P.R. Shearing, *Energy and Environmental Science* 10, 1287–1542 (2017)
- [59] *Degradation study by start-up/shut-down cycling of superhydrophobic electrospayed catalyst layers using a localized reference electrode technique*, P. Ferreira-Aparicio, A.M. Chaparro, M.A. Folgado, J.J. Conde, E. Brightman, G. Hinds, *ACS Applied Materials & Interfaces* 9, 10626-10636 (2017)
- [58] *Electrochemical pressure impedance spectroscopy applied to the study of polymer electrolyte fuel cells*, E. Engebretsen, T.J. Mason, P.R. Shearing, G. Hinds, D.J.L. Brett, *Electrochem. Commun.* 75, 60-63 (2017)
- [57] *Ex-situ characterisation of water droplet dynamics on the surface of a fuel cell gas diffusion layer through wettability analysis and thermal characterisation*, O.A. Obeisun, D.P. Finegan, E. Engebretsen, J.B. Robinson, O.O. Taiwo, G. Hinds, P.R. Shearing, D.J.L. Brett, *Int. J. Hydrogen Energy* 42, 4404-4414 (2017)
- [56] *Characterising the structural properties of battery polymer separators in 3D using phase contrast X-ray tomography*, D.P. Finegan, B. Tjaden, O.O. Taiwo, S.J. Cooper, J. Gelb, G. Hinds, D.J.L. Brett, P.R. Shearing, *J. Power Sources* 333, 184-192 (2016)
- [55] *Investigating lithium-ion battery materials during overcharge-induced thermal runaway: An operando and multi-scale X-ray CT study*, D.P. Finegan, M. Scheel, J.B. Robinson, B. Tjaden, M. Di Michiel, G. Hinds, D.J.L. Brett, P.R. Shearing, *Phys. Chem. Chem. Phys.* 18, 30912-30919 (2016)
- [54] *Study of superhydrophobic electrospayed catalyst layers using a localized reference electrode technique*, A.M. Chaparro, P. Ferreira-Aparicio, M.A. Folgado, E. Brightman, G. Hinds, *J. Power Sources* 325, 609-619 (2016)
- [53] *In operando investigation of anode overpotential dynamics in direct methanol fuel cells*, C. Rabissi, E. Brightman, G. Hinds, A. Casalegno, *Int. J. Hydrogen Energy* 41, 18221–18225 (2016)
- [52] *On the actual mixed potential in Direct Methanol Fuel Cells*, M. Zago, A. Bisello, A. Baricci, C. Rabissi, E. Brightman, G. Hinds, A. Casalegno, *J. Power Sources* 325, 714-722 (2016)

[51] *Microcrack clustering in stress corrosion cracking of 22 Cr and 25 Cr duplex stainless steels*, L. Wickström, K. Mingard, G. Hinds, A. Turnbull, Corros. Sci. 109, 86-93 (2016)

[50] *Novel approach to validation of thermodynamic models for the chemistry of oilfield environments*, J. Abda, H. Davies, G. Hinds, A. Turnbull, Corrosion 72, 587-597 (2016)

[49] *Quantifying bulk electrode strain and material displacement within commercial lithium batteries via high-speed operando tomography and digital volume correlation*, D.P. Finegan, E. Tudisco, M. Scheel, J.B. Robinson, D. Taiwo, D. Eastwood, P. Lee, M. Di Michiel, B. Bay, S. Hall, G. Hinds, D.J.L. Brett, P.R. Shearing, Adv. Sci. 3, 1500332 (2016)

[48] *Effect of pigging damage on sulphide stress corrosion cracking of corrosion resistant alloys*, J. Hesketh, G. Hinds, R. Morana, Corrosion 72, 439-448 (2016)

[47] *Electro-thermal impedance spectroscopy applied to an open-cathode polymer electrolyte fuel cell*, E. Engebretsen, J.B. Robinson, O. Obeisun, T. Mason, D. Finegan, G. Hinds, P.R. Shearing, D.J.L. Brett, J. Power Sources 302, 210-214 (2016)

[46] *Study of water accumulation dynamics in the channels of an open-cathode fuel cell through electro-thermal characterisation and droplet visualisation*, O.A. Obeisun, Q. Meyer, E. Engebretsen, D.P. Finegan, J.B. Robinson, G. Hinds, P.R. Shearing, D.J.L. Brett, Int. J. Hydrogen Energy 40, 16786-16796 (2015)

[45] *Detection of internal defects in lithium ion batteries using lock-in thermography*, J.B. Robinson, E. Engebretsen, D.P. Finegan, J. Darr, G. Hinds, P.R. Shearing, D.J. L. Brett, ECS Electrochemistry Letters 4, A106-A109 (2015)

[44] *Influence of weld preparation procedure and heat tinting on sulfide stress corrosion cracking of duplex stainless steel*, L. Wickström, G. Hinds, A. Turnbull, Corrosion 71, 1036-1047 (2015)

[43] *In-operando high-speed tomography of lithium-ion batteries during thermal runaway*, D.P. Finegan, M. Scheel, J.B. Robinson, B. Tjaden, I. Hunt, T.J. Mason, J. Millichamp, M. Di Michiel, G.J. Offer, G. Hinds, D.J.L. Brett, P.R. Shearing, Nat. Commun. 6, 6924 (2015)

[42] *Towards more representative test methods for corrosion resistance of PEMFC metallic bipolar plates*, G. Hinds, E. Brightman, Int. J. Hydrogen Energy 40, 2785-2791 (2015)

[41] *In situ characterisation of PEM water electrolyzers using a novel reference electrode*, E. Brightman, J. Dodwell, N. Van Dijk, G. Hinds, Electrochem. Commun. 52, 1-4 (2015)



- [40] *Multi-objective optimization of lithium-ion battery model using genetic algorithm approach*, L. Zhang, L. Wang, G. Hinds, C. Lyu, J. Zheng, J. Li, J. Power Sources 270, 367-78 (2014)
- [39] *In situ mapping of potential transients during start-up and shut-down of a polymer electrolyte membrane fuel cell*, E. Brightman, G. Hinds, J. Power Sources 267, 160-170 (2014)
- [38] *Parameter sensitivity analysis of cylindrical LiFePO<sub>4</sub> battery performance using multi-physics modeling*, L.Q. Zhang, C. Lyu, G. Hinds, L.X. Wang, W.L. Luo, J. Zheng, K.H. Ma, J. Electrochem. Soc. 161, A762-A776 (2014)
- [37] *Novel method for determination of pitting susceptibility in aggressive environments at elevated temperature and pressure*, G. Hinds, L. Wickström, J. Abda, A. Turnbull, V. Smith, R. Woollam, Corros. Sci. 85, 33-41 (2014)
- [36] *Non-uniform temperature distribution in Li-ion batteries during discharge – A combined thermal imaging, X-ray micro-tomography and electrochemical impedance approach*, J.B. Robinson, J.A. Darr, D.S. Eastwood, G. Hinds, P.D. Lee, P.R. Shearing, O.O. Taiwo, D.J.L. Brett, J. Power Sources 252, 51-57 (2014)
- [35] *Spatially resolved diagnostic methods for polymer electrolyte membrane fuel cells: a review*, C. Kalyvas, A. Kucernak, D. Brett, G. Hinds, S. Atkins, N. Brandon, WIREs Energy Environ. 3, 254-275 (2014)
- [34] *An electrochemical treatment to improve corrosion and contact resistance of stainless steel bipolar plates used in polymer electrolyte fuel cells*, E.M. Gabreab, G. Hinds, S. Fearn, D. Hodgson, J. Millichamp, P.R. Shearing, D.J.L. Brett, J. Power Sources 245, 1014-1026 (2014)
- [33] *Influence of acoustic cavitation on the controlled ultrasonic dispersion of carbon nanotubes*, A. Sesis, M. Hodnett, G. Memoli, A.J. Wain, I. Jurewicz, A.B. Dalton, J.D. Carey, G. Hinds, J. Phys. Chem. B 117, 15141-15150 (2013)
- [32] *In situ mapping of electrode potential in a PEMFC*, G. Hinds, ECS Transactions 58, 1565-1587 (2013)
- [31] *In situ measurement of active catalyst surface area in fuel cell stacks*, E. Brightman, G. Hinds, R. O'Malley, J. Power Sources 242, 244-247 (2013)
- [30] *Impact of surface condition on sulphide stress corrosion cracking of 316L stainless steel*, G. Hinds, L. Wickstrom, K. Mingard, A. Turnbull, Corros. Sci. 71, 43-52 (2013)
- [29] *Humidity, pressure and temperature measurements in an interdigitated-flow PEM hydrogen fuel cell*, S. Bell, G. Hinds, M. de Podesta, M. Stevens, J. Wilkinson, Int. J. Thermophys. 33, 1583-1594 (2012)

- [28] *In situ mapping of electrode potential in a PEM fuel cell*, G. Hinds, E. Brightman, *Electrochem. Commun.* 17, 26-29 (2012)
- [27] *Novel multi-electrode test method for inhibition of underdeposit corrosion Part 1: Sweet conditions*, G. Hinds, A. Turnbull, *Corrosion* 66, 046001-046001-10 (2010)
- [26] *Novel multi-electrode test method for inhibition of underdeposit corrosion Part 2: Sour conditions*, G. Hinds, A. Turnbull, *Corrosion* 66, 056002-056002-6 (2010)
- [25] *What Happens Inside a Fuel Cell? Developing an Experimental Functional Map of Fuel Cell Performance*, D.J.L. Brett, A.R. Kucernak, P. Aguiar, S.C. Atkins, N.P. Brandon, R. Clague, L.F. Cohen, G. Hinds, C. Kalyvas, G.J. Offer, B. Ladewig, R. Maher, A. Marquis, P. Shearing, N. Vasileiadis, V. Vesovic, *Chem. Phys. Chem.* 11, 2714-2731 (2010)
- [24] *Technical note: Measurement of pH in concentrated brines*, G. Hinds, P. Cooling, A. Wain, S. Zhou, A. Turnbull, *Corrosion* 65, 635-638 (2009)
- [23] *Electrocatalytic activity mapping of model fuel cell catalyst films by scanning electrochemical microscopy*, P. Nicholson, S. Zhou, G. Hinds, A. Wain, A. Turnbull, *Electrochim. Acta* 54, 4525-4533 (2009)
- [22] *Novel in-situ measurements of relative humidity in a PEMFC*, G. Hinds, M. Stevens, J. Wilkinson, M. de Podesta, S. Bell, *J. Power Sources* 186, 52-57 (2009)
- [21] *Chemistry of concentrated salts formed by evaporation of seawater on duplex stainless steel*, A. Turnbull, S. Zhou, P. Nicholson, G. Hinds, *Corrosion* 64, 323-333 (2008)
- [20] *Threshold temperature for stress corrosion cracking of duplex stainless steel under evaporative seawater conditions*, G. Hinds, A. Turnbull, *Corrosion* 64, 101-106 (2008)
- [19] *Technical note: Testing of supermartensitic stainless steel welds under cathodic protection at very low strain rates*, G. Hinds, A. Turnbull, *Corrosion* 62, 371-374 (2006)
- [18] *Influence of a magnetic field on the electrochemical rest potential*, F.M.F. Rhen, D. Fernandez, G. Hinds, J.M.D. Coey, *J. Electrochem. Soc.* 153, J1-J7 (2006)
- [17] *Technical note: Does calcareous scale formation on cathodically protected steel affect hydrogen uptake?*, G. Hinds, A. Turnbull, *Corrosion* 61, 835-837 (2005)
- [16] *Hydrogen diffusion in super 13 Cr martensitic stainless steel*, G. Hinds, J. Zhao, A.J. Griffiths, A. Turnbull, *Corrosion* 61, 348-354 (2005)

- [15] *Monotonic and cyclic slow strain rate testing of super 13 Cr steel welds under cathodic protection*, A.J. Griffiths, G. Hinds, A. Turnbull, Corrosion 61, 111-118 (2005)
- [14] *Influence of magnetic field and gravity on the morphology of zinc fractal electrodeposits*, T.R. Ní Mhíocháin, G. Hinds, A. Martin, E. Chang, A. Lai, L. Costiner, J.M.D. Coey, Electrochim. Acta 49, 4813-4828 (2004)
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- [4] *Influence of magnetic forces on electrochemical mass transport*, G. Hinds, J.M.D. Coey, M.E.G. Lyons, Electrochem. Commun. 3, 215-218 (2001)
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- [12] *Testing of inhibitors for underdeposit corrosion in sour conditions*, G. Hinds, P. Cooling, A. Turnbull, Eurocorr 09, Nice, 2009
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- [7] *Stress corrosion cracking of duplex stainless steel under simulated evaporative conditions*, A. Turnbull, G. Hinds, Paper no. 07474, Corrosion 2007, NACE Int., Houston, 2007
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- [67] Influence of H<sub>2</sub>S on the localised corrosion of 316L stainless steel: Part 1 – Immersion testing, J. Hesketh, E. Dickinson, G. McMahon, A. Turnbull, G. Hinds, NPL Report EET MAT 92, 2020
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- [55] *Effect of simulated pigging on the stress corrosion cracking resistance of*

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- [48] *Correlating microstructure and the onset of hydrogen induced cracking*, G. Hinds, M. Seraffon, N. McClelland, P. Cooling, A. Turnbull, NPL Report MAT (RES) 215, 2014
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- [30] *Evaluation of four-point bend test method for crevice corrosion cracking*, G. Hinds, P. Cooling, N. Street, NPL Test Report 2012020014-8, 2013
- [29] *Evaluation of HIC resistance of pressure vessel steel*, G. Hinds, N. Street, J. Doff, NPL Test Report 2012020014-9, 2013
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- [27] *Development of electrochemical test protocols for the prediction of localised corrosion in oil and gas applications*, G. Hinds, L. Wickström, A. Turnbull, NPL Report MAT (RES) 167, 2012
- [26] *Evaluation of inhibitor performance using NPL underdeposit corrosion test, Phase 2: Injection of inhibitor before sand deposition*, G. Hinds, NPL Test Report 2011050400, 2012
- [25] *Development of standard corrosion test protocol for engine lubricants: Phase 2*, G. Hinds, N. Street, P. Cooling, NPL Test Report 2012060123, 2012
- [24] *Pitting potential measurements on duplex stainless steel welds*, G. Hinds, S. Zhou, NPL Test Report 2012050472, 2012
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- [21] *Corrosion inhibitor testing under sour conditions*, G. Hinds, N. Street, NPL Test Report 2012010384, 2012
- [20] *Evaluation of inhibitor performance using NPL underdeposit corrosion test*, G. Hinds, NPL Test Report 2010080376, 2011
- [19] *Compatibility testing of candidate heat exchanger materials with R245fa refrigerant*, G. Hinds, L. Wickström, P. Cooling, NPL Report MAT (RES) 107, 2010
- [18] *Round robin testing of generic corrosion inhibitor using the bubble test and RCE test*, G. Hinds, NPL Test Report 2009090518, 2010
- [17] *Methodology for determining the resistance of metals to stress corrosion cracking using the four-point bend method*, G. Hinds, P. Cooling, A. Turnbull, NPL Report MAT (RES) 085, 2009
- [16] *Methodology for determining the resistance of metals to stress corrosion cracking using a creviced four-point bend method*, G. Hinds, P. Cooling, A. Turnbull, NPL Report MAT (RES) 081, 2009
- [15] *On the applicability of Scanning Kelvin Probe Force Microscopy as an electrochemical characterisation tool*, G. Hinds, NPL Report MAT (RES) 072, 2009
- [14] *Effect of inhibitor concentration on underdeposit corrosion of AISI 1018 carbon steel*, NPL Test Report E08050214, 2009

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- [11] *Pitting potential measurements of 316L stainless steel in pond water*, G. Hinds, NPL Test Report E08010475, 2008
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- [9] *Guide to durability testing of PEMFC electrocatalysts*, G. Hinds, DEPC MN 049, 2007
- [8] *Slow strain rate testing of AISI 1016 steel in nitrate solution*, G. Hinds, NPL Test Report E07020067, 2007
- [7] *Galvanic corrosion testing of 13 Cr steel and zinc alloy*, G. Hinds, NPL Test Report E07030164, 2007
- [6] *Failure analysis of AISI stainless steel wire*, G. Hinds, NPL Test Report E06090301, 2006
- [5] *Evaluation of pressure-balanced joint with respect to corrosion*, A. Turnbull, G. Hinds, S. Zhou, P. Cooling, NPL Report DPE-MPE (RES) 032, 2005
- [4] *Preparation and characterisation of PEM fuel cell electrocatalysts: a review*, G. Hinds, NPL Report DEPC-MPE 019, 2005
- [3] *Results of hydrogen permeation tests on Alloy 718 bolt*, G. Hinds, NPL Test Report E05060134, 2005
- [2] *Performance and durability of PEM fuel cells: a review*, G. Hinds, NPL Report DEPC-MPE 002, 2004
- [1] *Strategic overview of electrochemical technology in the UK*, G. Hinds, NPL Report DEPC-MPE 002 (RES), 2004

## **Presentations**

- [89] *Measurement challenges for hydrogen infrastructure*, University of Manchester seminar, online, April 2021 (invited)
- [88] *A combined in situ diagnostic and modelling approach to cost reduction in PEM water electrolyzers*, Henry Royce Institute Conference 2021, online, March 2021 (invited).

- [87] *Metrology challenges for hydrogen infrastructure*, H2FC Innovation Workshop, online, February 2021 (invited)
- [86] *Optimisation of electrochemical devices via in situ measurement and modelling*, FunMat-II Seminar, University of Linköping, online, December 2020 (keynote)
- [85] *Metrology and standards for battery research*, Faraday Institution Conference, online, November 2020 (keynote)
- [84] *A step change in the cost of PEM water electrolyzers?*, MRS Spring/Fall Meeting, online, November 2020 (keynote)
- [83] *Impact of H<sub>2</sub>S on localised corrosion of 316L stainless steel in oilfield environments*, Eurocorr 20, online, September 2020
- [82] *Decarbonisation of transport: where do batteries and hydrogen fit in?*, Technical Policy Division seminar, Ministry of Housing, Communities and Local Government, online, July 2020 (invited)
- [81] *Electrochemistry: an underpinning science with important practical applications*, STFC Batteries Webinar, online, June 2020 (invited)
- [80] *Cost reduction of water electrolyzers via insights into anode current collector corrosion*, World Corrosion Organisation Seminar, online, April 2020 (invited)
- [79] *A step change in the cost of PEM water electrolyzers?*, Regional Workshop on Green and Low Carbon Hydrogen Energy, Tokyo, online, March 2020 (invited)
- [78] *Decarbonisation of transport: where do batteries and hydrogen fit in?*, GSE Professional Learning & Development seminar, Department for Transport, March 2020 (invited)
- [77] *Local corrosion potential measurement at PEMWE current collectors*, ITM Power seminar, Sheffield, November 2019 (invited)
- [76] *How can the Institute of Corrosion adapt to thrive in a rapidly changing world?*, ICorr Aberdeen Branch talk, Aberdeen, October 2019 (invited)
- [75] *Model-based optimisation of three-electrode impedance measurements on Li-ion cells*, Electrical Engineering & Automation Seminar, Harbin Institute of Technology, October 2019 (invited)
- [74] *In situ and operando diagnostic techniques for assessment of Li-ion batteries*, Electrical Engineering & Automation Seminar, Harbin Institute of Technology, October 2019 (invited)

- [73] *Corrosion in fuel cells and electrolyzers*, International Conference on Corrosion Protection and Application 2019, Chongqing, China, October 2019 (keynote)
- [72] *A step change in the cost of PEM water electrolyzers?*, STFC Annual Conference, Abingdon, July 2019 (invited)
- [71] *How can the Institute of Corrosion adapt to thrive in a rapidly changing world?*, ICorr Midlands Branch talk, Birmingham, May 2019 (invited)
- [70] *The death of the internal combustion engine: what comes next?*, Science Discovery Group talk, Havant, May 2019 (invited)
- [69] *Operando measurement of local current collector potential in PEM fuel cells and electrolyzers*, STFC Early Career Researcher Forum, Abingdon, March 2019 (plenary)
- [68] *How can the Institute of Corrosion adapt to thrive in a rapidly changing world?*, ICorr London Branch talk, London, March 2019 (invited)
- [67] *The death of the internal combustion engine: what comes next?*, Long Range Research Lecture Series, Shell Global Solutions, Amsterdam, March 2019 (invited)
- [66] *The death of the internal combustion engine: what comes next?*, MMN talk, NPL North, Huddersfield, January 2019 (invited)
- [65] *Metrology for high energy density batteries: supporting the Faraday Challenge*, Blue Scientific Battery Workshop, UCL, November 2018 (invited)
- [64] *Understanding thermal runaway in Li-ion batteries*, Portsmouth and District Physical Society Lecture, Portsmouth, November 2018 (invited)
- [63] *The death of the internal combustion engine: what comes next?*, IET Lecture, Teddington, October 2018 (invited)
- [62] *Influence of microporous layer on corrosion of PEMFC metallic bipolar plates*, Advanced Energy Materials 2018, University of Surrey, September 2018 (keynote)
- [61] *In situ accelerated stress testing of electrolyzers*, Chemical Engineering Seminar, UCL, May 2018 (invited)
- [60] *New insights into corrosion of metallic bipolar plates in polymer electrolyte membrane fuel cells*, Corrosion 18, Phoenix, USA, April 2018 (invited)
- [59] *In situ diagnostics for PEM fuel cells and electrolyzers*, NIST, Gaithersburg, USA, April 2018 (invited)
- [58] *What will drive our cars when the combustion engine dies?*, The Register Lecture Series, London, January 2018 (invited)

- [57] *The materials challenge of fuel cells*, Birmingham Metallurgy Association, Birmingham, November 2017 (invited)
- [56] *Experimental validation of pH models for oil and gas applications*, Eurocorr 17, Prague, September 2017
- [55] *In situ diagnostics for PEM fuel cells and electrolyzers*, International Graduate School of Metrology, Kloster Drübeck, Germany, August 2017 (invited)
- [54] *In situ diagnostics for PEM fuel cells and electrolyzers*, STFC Annual Meeting, Abingdon, May 2017 (invited)
- [53] *In situ diagnostics for fuel cells and batteries*, Electrical Engineering & Automation Seminar, Harbin Institute of Technology, April 2017 (invited)
- [52] *Role of H<sub>2</sub>S in localized corrosion and cracking of CRAs in upstream oil and gas applications*, Corrosion 17, New Orleans, USA, March 2017
- [51] *Decarbonising the UK – how can electrochemistry help?*, Physics Seminar, University of Sussex, March 2017 (invited)
- [50] *Novel approach to validation of thermodynamic models for the chemistry of oilfield environments*, Eurocorr 16, Montpellier, September 2016
- [49] *In situ study of metallic bipolar plate corrosion during PEMFC operation*, FCH2 Conference 2016, Birmingham, May 2016 (invited)
- [48] *Fuel cells and hydrogen – moving towards a low carbon economy*, Winton Seminar, Cambridge, April 2016 (invited)
- [47] *Study of fuel cell and electrolyser catalyst degradation using a novel reference electrode technique*, EMN 2016, Dubai, April 2016 (invited)
- [46] *Corrosion and environment induced cracking*, Chemical Engineering Seminar, University of Strathclyde, March 2016 (invited)
- [45] *Influence of surface condition on environment assisted cracking of corrosion resistant alloys*, Corrosion 16, Vancouver, Canada, March 2016 (invited)
- [44] *Fuel cell reference electrode development at NPL*, Electrochemistry Seminar, Paul Scherrer Institute, Villigen, Switzerland, February 2016 (invited)
- [43] *Underdeposit corrosion in oil and gas applications*, MEPIPES 2015, Manama, Bahrain, October 2015 (invited)

- [42] *Catalyst degradation in PEM fuel cells and electrolyzers*, 3<sup>rd</sup> International Workshop on Degradation Issues of Fuel Cells and Electrolyzers, Santorini, Greece, September 2015 (invited)
- [41] *Corrosion resistance of metallic PEMFC bipolar plates: towards a more representative test method*, 3<sup>rd</sup> International Workshop on Degradation Issues of Fuel Cells and Electrolyzers, Santorini, Greece, September 2015 (invited)
- [40] *Underdeposit corrosion in oil pipelines*, Knowledge Transfer Corrosion Matters Workshop, London, June 2015 (invited)
- [39] *Influence of weld preparation procedure and heat tinting on SSC of duplex stainless steel*, Fitness for service - Plant life extension, Corrosion Monitoring, NDT, Institut de Soudure, Paris, May 2015 (invited)
- [38] *Corrosion of metallic bipolar plates for PEMFCs: towards a more representative test method*, International Workshop on Bipolar Plates for PEM Technology, Sattledt, Austria, May 2015 (invited)
- [37] *In situ diagnostics for PEM fuel cells and electrolyzers*, FCH2 Conference 2015, Birmingham, May 2015 (invited)
- [36] *Electrochemical techniques for materials selection in aggressive environments*, SCC Workshop, University of Manchester, April 2015 (invited)
- [35] *Novel approach to validation of thermodynamic models for the chemistry of oilfield environments*, Corrosion 15, Dallas, Texas, March 2015
- [34] *Influence of weld preparation procedure and heat tinting on SSC of duplex stainless steel*, Corrosion 15, Dallas, Texas, March 2015
- [33] *Fuel cell metrology – supporting the transition to a low carbon economy*, Chemical Engineering Seminar, University of Surrey, December 2014 (invited)
- [32] *Underdeposit corrosion in oil and gas applications*, Gordon Conference (Corrosion), New London, New Hampshire, July 2014 (invited)
- [31] *Towards a more representative corrosion test method for metallic PEMFC bipolar plates*, 3<sup>rd</sup> H2FC Technical School, Rethymnon, Crete, June 2014
- [30] *Investigation of PEMFC start-up/shut-down degradation using reference electrode array*, H2FC Materials Workshop, San Sebastian, Spain, March 2014 (invited)
- [29] *In situ mapping of electrode potential in a PEMFC*, 224<sup>th</sup> Electrochemical Society Meeting, San Francisco, October 2013 (invited)

- [28] *Novel developments in the characterisation of localised corrosion of CRAs in oil and gas environments*, ICorr/LMS meeting, Naval Club, Mayfair, October 2013 (invited)
- [27] *Novel developments in the characterisation of localised corrosion of CRAs in oil and gas environments*, Eurocorr 13, Estoril, September 2013
- [26] *Issues in qualification testing of corrosion resistant alloys for oil and gas applications*, Corrosion UAE 2013, Abu Dhabi, United Arab Emirates, February 2013 (invited)
- [25] *Understanding the early stages of damage development in corrosion resistant alloys*, MEPIPES 2013, Abu Dhabi, United Arab Emirates, February 2013 (invited)
- [24] *Fuel cell metrology at NPL*, Energy Storage Systems Workshop, Berlin, December 2012 (plenary)
- [23] *Strengthening the link between laboratory testing and material performance in service*, Oil & Gas Pipes 2012, London, November 2012 (invited)
- [22] *In situ mapping of electrode potential in a PEMFC using a novel reference electrode*, Fuel Cell Advances, Berlin, April 2012
- [21] *Evaluation of inhibitors for underdeposit corrosion using a novel multi-electrode test method*, MEPIPES 2011, Abu Dhabi, United Arab Emirates, May 2011 (invited)
- [20] *Fuel cell modelling and model validation via in situ measurement*, Fuel Cells Science & Technology 2010, Zaragoza, Spain, October 2010 (keynote)
- [19] *Corrosion monitoring in the oil and gas industry*, CED Workshop, Warrington, April 2010 (invited)
- [18] *Fuel cells: measurement and standardisation needs*, Measurement Needs for Emerging Materials and Technologies, VAMAS, New Delhi, March 2010 (invited)
- [17] *Testing of inhibitors for underdeposit corrosion in sour conditions*, Eurocorr 09, Nice, September 2009
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