

## Martyn Gordon Boutelle Ph.D

### Contact details

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### Brief Biography

I graduated from the Department of Chemistry at Imperial College and then stayed at Imperial College for a PhD in fundamental electrochemistry working with Professor WJ Albery FRS. I moved to the area of in vivo electrochemical monitoring of neurochemicals when I moved to Oxford Physiology Department to work with Dr Marianne Fillenz. My introduction to microfabrication came in joint work with Marianne and Professor Allen Hill FRS. My first academic post was as a physical/analytical chemist at King's College London, moving to Imperial College Department of Bioengineering in 2005. My research has always involved strong collaborative links with other neuroscientists, and clinicians.

### Employment History

2011 – present Professor of Biomedical Sensors Engineering  
Department of Bioengineering, Imperial College London  
2004 – 2011 Reader in Biomedical Sensor Engineering  
Department of Bioengineering, Imperial College London  
Sept-Dec 2004 Reader in Biomedical Analysis,  
Department of Chemistry, King's College London  
1996 - 2004 University Lecturer in Physical and Analytical Chemistry  
Department of Chemistry, King's College London  
1990 - 1994 E. P. Abraham Research Fellowship at Green College, University of Oxford  
1992- 1996 Research fellow in New Chemistry Laboratory, Oxford University  
1984 - 1992 Research Fellow, University Laboratory of Physiology, University of Oxford

### University Education

1977 - 80 BSc (Hons) 1<sup>st</sup> Class Chemistry, ARCS, Imperial College London  
1980 - 83 PhD, DIC in Physical Chemistry Imperial College London, Thesis Title "The Development of Modified Electrodes" Supervisor: Prof. W.J. Albery FRS

**Esteem and professional activities** More than 110 peer reviewed publications with 2557 citations and a personal h-index of 34. Program chair of Bioengineering 2008, International advisory board for the International Society of Monitoring Molecules in Neuroscience, Conference chair for Monitoring Molecules in Neuroscience 2012, Chair of COSBID 2012, Invited member Wellcome Trust expert review committee (2010)

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### **Research Interests**

My biomedical monitoring research group is multidisciplinary, embracing both the development of fundamental physical/ analytical science methods and the use of these new techniques in a programme of neuroscience and clinical science research. My approach is to combine real-time measurement of neurochemical, electrical and physical measurements such as blood flow and local brain pressure to give a clear picture of the dynamics of tissue response to stimulation or trauma. The same measurement techniques are used in patients and in experimental models allowing genuine translational research.

### **Measurement methodologies**

- Use of microdialysis to sample tissue in real-time
- Microfabricated microdialysis sampling devices
- Digital microfluidics - microfabricated flow-segmentation devices for microdialysis
- Low volume on-line electrochemical sensor systems using microelectrodes
- Development of biosensor systems for key neurochemicals and energy metabolites
- Optimisation of biosensor systems for monitoring cell culture
- Design of computerised instrumentation.
- Development of signal processing algorithms to fuse data from different real-time measurement techniques
- Measurement of local blood flow using laser speckle methods
- Measurement of brain electrical activity - electrocorticography
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### **Clinical and neuroscience research**

- Clinical detection and characterisation of spontaneous electrical depolarisation waves in traumatic brain injury patients.
- Clinical monitoring of neurochemistry in brain injury in traumatic brain injury patients
- Translational study of transient neurochemical mechanisms underlying brain injury
- Development of energy budgets for neurotransmission
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- Clinical monitoring to detect ischaemia during free flap reconstructive surgery
- Clinical monitoring of 'at risk' bowel during and following surgery
- Development of monitoring system for transplanted kidneys
- Development of a point of care test for obstetric cholestasis - a key risk factor for the development of pre-eclampsia in pregnant women

Future plans include building a new class of clinical instrument for monitoring of human brain injury; building microfabricated neurochemical analysis systems for neuroscience,

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### Recent key papers

Rogers, M. L.; Boutelle, M. G.: Real-Time Clinical Monitoring of Biomolecules. *Annual Review of Analytical Chemistry* **2013**, 6, 427-453.

#### Brain

Cortical spreading depression and peri-infarct depolarisation in acutely injured human cerebral cortex. M Fabricius, S Fuhr, R Bhatia, MG Boutelle, P Hashemi, AJ Strong, M Lauritzen. (2006) *Brain*, 129, 778-790

Persistent depletion of brain glucose following cortical spreading depression despite apparent hyperaemia. – Evidence for a pathogenic effect of Leão's spreading depression. P. Hashemi, R. Bhatia, H. Nakamura, JP Dreier, R. Graf, AJ Strong, M G Boutelle *J. Cerebral Blood Flow and Metabolism* (2009) 29 .166-175

Dynamic metabolic response to multiple spreading depolarisations in patients with acute head injury: an online microdialysis study. D Feuerstein, A Manning, P Hashemi, R Bhatia, M Fabricius, P Clemens, M Ervine, A J Strong, M G Boutelle. *J. Cerebral Blood flow and Metabolism* (2010) 30 1343-1355

Rogers, M. L.; Feuerstein, D.; Leong, C. L.; Takagaki, M.; Niu, X.; Graf, R.; Boutelle, M. G.: Continuous Online Microdialysis Using Microfluidic Sensors: Dynamic Neurometabolic Changes during Spreading Depolarization. *ACS Chemical Neuroscience* **2013**, 4, 799-807.

Jeffcote, T.; Hinzman, J.; Jewell, S.; Learney, R.; Pahl, C.; Tolia, C.; Walsh, D.; Hocker, S.; Zakrzewska, A.; Fabricius, M.; Strong, A.; Hartings, J.; Boutelle, M.: Detection of Spreading Depolarization with Intraparenchymal Electrodes in the Injured Human Brain. *Neurocrit Care* **2013**, epub 1-11.

#### Methods

Practical methods for Noise removal: applications to spikes, non-stationary quasi-periodic noise and baseline drift. D Feuerstein, K Parker, M G Boutelle, *Analytical Chemistry* (2009) 82, 4987-4994

ATP microelectrode biosensor for stable monitoring from in vitro gastrointestinal tissue. *Biosensors and Bioelectronics*, BA Patel, M Rogers, T Wieder, D O'Hare, MG. Boutelle. (2011) 26, 2890–2896

Optimisation of a microfluidic analysis chamber for the placement of microelectrodes., M Rogers, Chi Leong, X. Niu, A de Mello, KH Parker, MG Boutelle,. (2011) *Phys. Chem. Chem. Phys.* 13, 5298–5303

Sansuk, S.; Bitziou, E.; Joseph, M. B.; Covington, J. A.; Boutelle, M. G.; Unwin, P. R.; Macpherson, J. V.: Ultrasensitive Detection of Dopamine Using a Carbon Nanotube Network Microfluidic Flow Electrode. *Analytical Chemistry* **2012**, 85, 163-169.

Kothur, R. R.; Hall, J.; Patel, B. A.; Leong, C. L.; Boutelle, M. G.; Cragg, P. J.: A low pH sensor from an esterified pillar[5]arene. *Chemical Communications* **2014**, 50, 852-854.

#### Free Flap

Rogers, M. L.; Brennan, P. A.; Leong, C. L.; Gowers, S. A.; Aldridge, T.; Mellor, T. K.; Boutelle, M. G.: Online rapid sampling microdialysis (rsMD) using enzyme-based electroanalysis for dynamic detection of ischaemia during free flap reconstructive surgery. *Analytical and bioanalytical chemistry* **2013**, 405, 3881-8