

JSPS London Research Report

Dr. Benjamin Lowe

ben.lowe.uk@googlemail.com

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Host Institution: University of Tokyo

Host Department: Department of Materials Engineering

Host Name: Toshiya Sakata (Host) and Yasushi Shibuta (co-supervisor)

UK Institution: University of Southampton

UK Supervisors: Nicolas Green and Chris Skylaris

Research Summary:

Field-Effect Transistor-sensors (FET-sensors) are a type of pH/biomolecule sensor that can be produced at a low cost and with high sensitivity, as a result having potential for commercialisation and widespread use. The underlying physics of how these devices fundamentally operate remains poorly understood, which is currently hindering the rational design and improvement of these devices for commercial applications. This JSPS Short-Term post-doctoral position research was towards improving understanding of the fundamental physics at the surface of these devices – the glass-water-(bio)molecule interface. In this work we presented a proof-of-concept for a novel molecular-resolution simulation methodology which provides predictions of sensor response with unprecedented detail [1,2]. We also used this simulation to predict the effects of changes in surface nano-morphology on sensor response, as this cannot be described using conventional models. I attended two local conferences and one international conference, all based in Japan.

References:

[1] B. M. Lowe, C.-K. Skylaris, N. G. Green, Y. Shibuta and T. Sakata. 'Molecular Dynamics Simulation of Potentiometric Sensor Response: Effect of Biomolecules, Surface Morphology and Surface Charge', *Nanoscale*, (accepted pending minor revisions), (2018).

[2] B. M. Lowe, C.-K. Skylaris, N. G. Green, Y. Shibuta and T. Sakata. 'Calculation of the Surface Potential of the Silica-Water Interface using Molecular Dynamics: Challenges and Opportunities', *Japanese Journal of Applied Physics*, 57, (2018), 04FM02, doi: [10.7567/JJAP.57.04FM02](https://doi.org/10.7567/JJAP.57.04FM02)

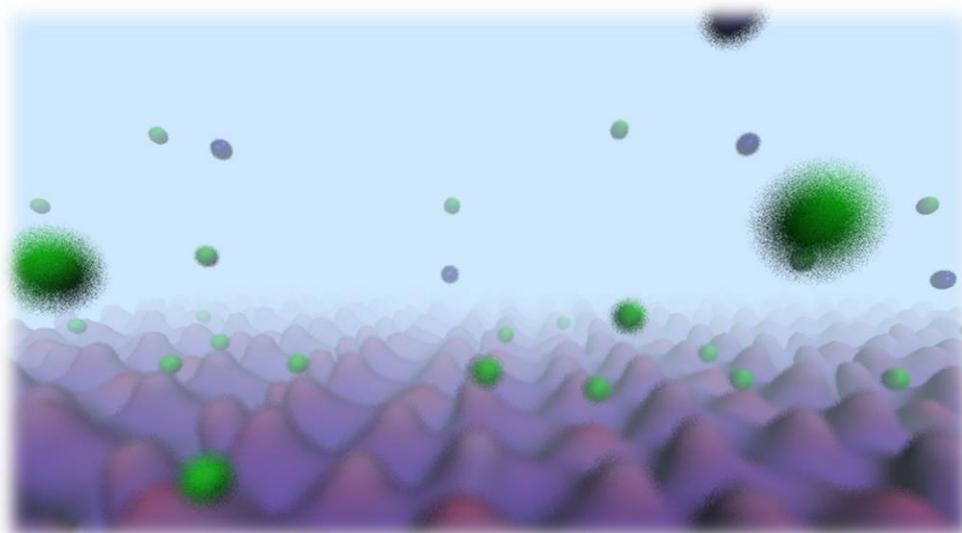


Figure 1 – Snapshot from molecular dynamic simulation of the silica-water surface. Water molecules are hidden, sodium ions are shown in green and the surface is shown in purple.

Tips and Advice

- Enjoy the many festivals in Japan, particularly in summer. Websites like JapanGuide.com and TokyoCheapo.com (for Tokyo) are excellent resources
- The extent that Japanese is used in research settings is heavily dependent on the research lab – for example, usually if a lab has many international members the language of weekly meetings will be English, otherwise usually Japanese.
 - My colleagues were all extremely friendly and supportive, with varying levels of English from fluent to unable to speak. All academics in Japan are able to read English, but whether they have the confidence/experience to speak is not guaranteed.
- If you're based in a large city, then Japanese will not be essential, but it's almost guaranteed that every word you learn will come in useful at some point – so learning is a great investment. If you're not in a large city, then learning basic Japanese would likely be essential.
 - I believe textfugu.com and wanikani.com are some of the best resources for efficient learning. anki.com also provides software to learn languages efficiently and offers free downloadable flashcard decks
- Gift-giving is important in Japan (e.g. "omiyage", White Day, moving-in gifts to neighbours etc.), so I recommend you bring some consumable souvenirs from your home country as a welcome gift, when starting your placement.