

PhD studentship, Durham, October 2016:

## *Surface Chemical Processes under Flow*

Practical applications that deposit or remove materials from surfaces often occur in a flowing liquid. The liquid applies a shear force to the surface and convection in the liquid can deliver material or reagents to a surface and remove other materials or reaction products. This project aims to understand surface chemical processes that are important in automatic dishwashers, but the insights gained will be relevant to a wide range of practical applications.

The removal of food deposits in dishwashers occurs under conditions of droplet impact (either from primary droplets or from secondary splashes), or under thin-film shear flow as a water sheet drains from a hard surface. The primary mechanism of removal of insoluble deposits is enzymatic digestion by proteases. The wash fluid also contains suspended particulates that must not be redeposited onto surfaces. Today, there is little quantitative understanding of how local hydrodynamics affects, for example, enzymatic digestion of proteinaceous soils or attachment of particles to surfaces.

There are two main aspects to this project.

- (i) Development of experimental rigs to mimic the flow conditions occurring in a dishwasher within a cell that has well-controlled hydrodynamics.
- (ii) Use of these rigs to study chemical and physical processes occurring on hard surfaces, including the attachment and detachment of particles and the enzymatic removal of a model protein film.

A range of techniques will be employed including high-speed photography and image analysis to determine the flow conditions at surfaces, evanescent wave light scattering to study particle dynamics, evanescent wave spectroscopy to study chemical reactions, and reflectometry or ellipsometry to study swelling of protein films and digestion by an enzyme. Quantitative kinetic models will be developed to reveal the role of local hydrodynamics in physical and chemical processes at surfaces.

Applications are invited from enthusiastic and motivated physical chemists or chemical engineers who have (or expect to obtain) at least the equivalent of a UK 2.i honours masters level degree in a relevant subject. The position is an industrial CASE award sponsored by Procter and Gamble and is available from October 2016 with a duration of 4 years, including a secondment to the company.

**The position is only open to applicants who are resident in the UK for fee purposes.**

Applicants should contact Prof. Colin Bain ([c.d.bain@durham.ac.uk](mailto:c.d.bain@durham.ac.uk)) with a covering letter, cv and the names of two suitable referees. Potential applicants are also welcome to contact Prof. Bain with informal enquiries.

**Early applications are strongly encouraged.** The position will be filled when a suitable candidate is identified.

**Closing date: 1 July 2016.**