



PhD Studentship Advertisement

Controlling Reservoir Formation at the Air/Water Interface by Nanoparticle Design: a bridge from Biocompatible Model Systems to Lung Surfactant Function



Richard A. Campbell (University of Manchester) & Armando Maestro (Institut Laue-Langevin)

Summary - This is a PhD project at the interface between physical chemistry and physical pharmacy that combines the use of several interfacial tools including neutron reflectometry and laser reflection techniques to understand and control the use of nanoparticles in tuning reservoir formation at the air/water interface. The work aim at: (1) improving the fundamental understanding of controlled reservoir formation in fluid monolayers from synthetic through to biocompatible systems, (2) providing insight into rational nanoparticle design in the formation of reservoirs of hierarchical structures, and (3) bridging the knowledge gap in reservoir formation from model phospholipid systems to lung surfactant substitutes of relevance to babies born with breathing difficulties.

Project Details - The work stems from a sustained experimental campaign by Campbell and co-workers to understand the properties of oppositely charged polyelectrolyte-surfactant mixtures at the air/water interface in terms of non-equilibrium effects. Persistent kinetically-trapped states created as the components first interact have been shown to have lasting effects on the behaviour of these systems. Work has been carried out to exploit these effects in order to create super-efficient fluid films that have superior properties to surface layers formed at equilibrium. Excitingly, it has been shown recently that reservoirs of material can be formed when the films are compressed according to the charge and structure of particles that are trapped in them. Observations of extended structures in fluid films have been made before, but this is the first time that their existence has been switched on and off in such a controlled way. At the same time, Maestro is an expert in the behaviour of systems involving nanoparticles and in particular their film properties. The project therefore combines the expertise of the two scientists in a new direction: to design optimum nanoparticles to tune reservoir formation in a range of synthetic, biocompatible and biologically-relevant systems. In fact analogy in the behaviour of the films studied to date can be made with reservoir formation in lung surfactant, where vital extended structures of phospholipids are mediated by specific proteins when we breathe. At the same time, there are important differences in the behaviour of the systems as well: work is required to bridge the gap between the synthetic films already studied and lung surfactant. This can be important as babies can be born without the appropriate protein balance to allow respiration. Work to design synthetic therapies may have important clinical relevance. The project is set up in key collaboration with leading experts in polyelectrolyte-surfactant mixtures (Eduardo Guzmán, Complutense University of Madrid, Spain), biocompatible nanoparticle design (Luis Liz-Marzán, CIC biomaGUNE, Spain) and lung surfactants (Marie Pierre Krafft, University of Strasbourg, France).

Practical Information - The successful candidate will be enrolled in the doctoral school at the University of Manchester (United Kingdom), although he/she will be based full-time at the Institut Laue-Langevin (Grenoble, France). Here the world leading neutron reflectometer FIGARO is situated as well as a suite of complementary techniques in the Partnership for Soft Condensed Matter. A secondment in the laboratory of at least one of the key collaborators mentioned above will be arranged. Starting date: September 2018.

Related reading - Langmuir 2018, 34, 2312 (reservoir formation); Nanoscale, 2017, 9, 18343 (nanoparticle films); J. Phys. Chem. C 2018, 122, 4419 (polyelectrolyte-surfactant mixtures); ACS Nano 2010, 4, 3591 (nanoparticle design); Angew. Chem. Int. Ed. 2015, 54, 8402 (lung surfactants).

Supervisors & contact info - Dr Richard Campbell (richard.campbell@manchester.ac.uk; University of Manchester, UK) and Dr Armando Maestro (maestro@ill.eu; Institut Laue-Langevin, Grenoble, France).

How to apply - Please send a cover letter, a detailed CV including academic records, and the names and contact details of two referees to the two supervisors.

Salary - Up to 3 years of funding with a gross salary of around 2350 euros/month (for more details see <https://www.ill.eu/careers/all-our-vacancies/phd-recruitment/phd-work-at-the-ill/>).