Molecular interactions between ultra-hydrophobic thyroid/sex hormones and surfaces:

Enabling the novel U-RHYTHM biomedical technology

Supervisory team

Main supervisor: Prof. Wuge Briscoe (School of Chemistry, University of Bristol)
Second supervisors: Dr Thomas Upton and Prof. Stafford Lightman *FRS* (Bristol Medical School); Prof. Alan Champneys (Department of Mathematics, University of Bristol)
Collaborators: Prof. Ian Craddock (School of Engineering, University of Bristol); Mr Robin Crossley (DesignWorks Windsor); Prof. Colin Dayan (Cardiff University), Prof. Ido Kema (University Medical Centre Groningen): Dr Suvi Ruuskanen (University of Turku, Finland)

Host institution: University of Bristol
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Project description

Rhythms characterise all living things, and our physiology can be a considered as a state of continuous dynamic equilibrium. Despite this, almost all clinical tests of human health consist of single time point measurements, which inevitably do not reflect normal and inherent daily or even hourly variation. To overcome this, we have developed a novel microdialysis-based ambulatory technology which allows 24-hour ambulatory, minimally invasive, blood free sampling (URHYTHM, www.u-rhythm.co.uk/; www.designworks.studio/ultradian-u-rhythm).

Using the technique, we have successfully demonstrated the dynamics of adrenal hormones including the stress hormone cortisol in hundreds of human participants (www.ultradian.eu). To broaden the use and impact of the technique, we now wish to investigate the use of U-RHYTHM to understand dynamics of other hormones crucial to normal growth and development and cytokines involved in many inflammatory diseases. Many of these-including sex hormones and thyroid hormones- are ultra-hydrophobic, resulting in their binding to the surface of both our plastic tubing and the U-Rhythm collecting device. In this project, the student will define the interactions between these hormones and plastic surfaces and develop a strategy to prevent this binding and allow us to utilise our device in many important clinical conditions. The student will be encouraged to work closely with our clinical teams working on both endocrine and rheumatological/ inflammatory diseases.

Amphiphilic polymers and surface functionalisation techniques such as plasma and UV-ozone treatment will be explored to functionalise the polymer/plastic surface to tailor the interactions with the hormones. The project will be based at the University of Bristol within the School of Chemistry and the Laboratory for Integrative Neuroscience and Endocrinology. The student will also work with our colleagues in the School of Mathematics to learn techniques for the analysis and interpretation of dynamic data and will be encouraged to collaborate with other members of our multidisciplinary team.

Advanced physicochemical techniques will be used to probe such interactions and interrogate the surface, including QCM-D, AFM, XPS, and fluorescence electron microscopy, and contact angle goniometry. Neutron and X-ray scattering at central facilities in the UK and France will be used to unravel the structure of hormones complexed with polymers in the solution and at the surface. The student will also have the collaboration opportunity for extended research visits in Krakow, Stockholm, and Brussels as well as the mass spectrography centres in Groningen and Turku.

Potential applicants (UK residents or EU citizens with settled status) should have a strong 4-year degree in Chemistry, Physics, Engineering, Biochemistry, or Biomedical Sciences. To apply to Bristol Chemistry, please follow the link here. For further information, please email Professor Wuge H. Briscoe wuge.briscoe@bristol.ac.uk or Professor Stafford Lightman Stafford.Lightman@bristol.ac.uk; or chem-pg-admissions@bristol.ac.uk.