SEAHA CENTRE FOR DOCTORAL TRAINING IN SCIENCE AND ENGINEERING IN ARTS HERITAGE AND ARCHAEOLOGY

Fully Funded Studentship:

Nanoscale strategies for the consolidation of cellulose in cultural heritage

While much research has been devoted to studies of the paint layer, it is the canvas that provides crucial mechanical support to it. This is particularly of concern to contemporary canvases because these are still 'treatable', while older canvases are usually lined, or so degraded that any stabilisation treatment would only have a limited effect. It has recently been highlighted that cellulose-based artefacts are deteriorating rapidly as a result of two interconnected degradation pathways: the acid hydrolysis of glycosidic bonds and oxidation. Low pH values can lead to cellulose de-polymerization even at room temperature. Protons hydrolyze the glycosidic bond of cellulose leading to a decrease of the chain length at the microscopic scale and to a loss of mechanical resistance at the macroscopic scale. Although the degradation process starts of the nanoscale level, it propagates throughout the entire cellulose ultrastructure and result in macro-scale damage affecting greatly the stability of the paint layer.

With recent developments in functionalized biopolymers (amorphous and crystalline nanocellulose) and with the possibility of embedding alkaline nanoparticles (alkaline hydroxide/carbonates nanoparticles) for the treatment of fibre-based artefacts canvases, it is now possible to both strengthen fibres and control the pH to prevent degradation. However, the mode of interaction between these new functionalized biopolymers and existing cellulose fibres needs to be understood in far greater details in order to advise both materials scientists and conservators alike about the merits or limitations of these new materials. Therefore, a systematic characterisation needs to be carried out to assess the interaction of such functionalized biopolymers with intact and damaged cellulose fibres using a multi-scale approach including tools such as atomic force microscopy, SEM-based computer tomography, dynamic mechanical analysis, and infrared spectroscopy for example.

The following research questions are of interest:

(i) Is there a correlation between losses of structural, mechanical, and chemical properties at the single cellulose fibril level?
(ii) Is it possible to consolidate damaged cellulose fibres using the aforementioned nanocellulose materials at the mesoscale (cellulose fibre >0.5mm in diameter)?
(iii) Does the functionalisation of the nanocellulose with deacidification agents improve the resistance of the consolidated fibrils to deacidification?
(iv) What are the overall impacts of such conservation strategies on cellulose-based cultural artefacts – a case study?

The project is part of the EPSRC Centre for Doctoral Training in Science and Engineering in Arts, Heritage and Archaeology at University College London, University of Oxford and University of Brighton (www.seaha-cdt.ac.uk), in collaboration with the Aurelia Chevalier, Paintings Conservator – Paris France) and Manfred Anders (ZFB Zentrum für Bucherhaltung GmbH, Germany). Co-funded by the Engineering and Physical Sciences Research Council (EPSRC) through the Centre for Doctoral Training and the newly awarded H2020 European Project - NanoRestart, the four year doctoral research programme will be supervised jointly by UCL Institute for Sustainable Heritage (http://www.bartlett.ucl.ac.uk/heritage) during the 1st year and then by Dr Laurent Bozec from the

(UCL Eastman Dental Institute), Dr Marianne Odlyha (Birkbeck College) and Dr Aurelia Chevalier For further details contact Dr Laurent Bozec, l.bozec@ucl.ac.uk the principal academic supervisor.

As a SEAHA student, you will have unparalleled access to expertise and research infrastructure across three universities and almost 50 research, heritage and industrial partners. In addition to the university doctoral training requirements, SEAHA students study together as a cohort and are involved in an exciting range of cohort activities, ranging from residential events and group projects, to conferences and careers events. Please visit the SEAHA website (www.seaha-cdt.ac.uk) for details.

The Studentship will cover home fees and a stipend of up to a maximum of £16,726 per year (current rate) for eligible UK/EU applicants, and a substantial budget for research, travel, and cohort activities.

Your application should include:

- A covering letter clearly stating:
  - Your motivation and how the course will contribute to your career development
  - Your residency status and eligibility for funding according to the information provided http://www.seaha-cdt.ac.uk/opportunities/eligibility-criteria/, or how you intend to sponsor your studies if not eligible for funding
  - Your academic eligibility
- Names of two academic referees (or one academic and one professional if applicable)
- Proof of meeting the UCL English language proficiency requirements where necessary. For SEAHA candidates, an advanced level certificate is normally required (details of English language proficiency requirements can be found at http://www.ucl.ac.uk/prospective-students/graduate/apply/english-language/index)
- A short research proposal (max. 2000 words) written by taking into consideration the above research questions

The award will be subject to a Grant Agreement between University College London, Aurelia Chevalier SME and ZFB Zentrum für Bucherhaltung GmbH.

Applications should be sent by email directly to:
SEAHA Centre Manager
manager@seaha-cdt.ac.uk
UCL Institute for Sustainable Heritage

Application deadline: Midnight (GMT), Sunday 28th June 2015 for interview on the 6th July 2015 and a start in mid-September 2015.

UCL Taking Action For Equality.