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

SEAHA Studentship: Plastics in Museum Collections – a study of their chemical and physical degradation using a System Dynamics approach

The EPSRC Centre for Doctoral Training in Science and Engineering in Arts, Heritage and Archaeology (SEAHA) at University College London, University of Oxford and University of Brighton, in collaboration with the Museum of London and Lacerta Technology Ltd is seeking applications for a fully funded studentship on the topic "Plastics in Museum Collections – a study of their chemical and physical degradation using a System Dynamics approach". Funded by the Engineering and Physical Sciences Research Council (EPSRC) through the SEAHA Centre for Doctoral Training, the four-year doctoral research project will be supervised jointly by the UCL Institute for Sustainable Heritage, UCL Chemistry, the Museum of London and Lacerta Technology Ltd.

This project will develop a new approach to studying material degradation, by viewing objects as complex systems that undergo multiple chemical and physical degradation processes. This work will be done in the framework of the ERC Starting Grant funded project "*COMPLEX: The Degradation of Complex Modern Polymeric Objects in Heritage Collections: A System Dynamics Approach*". Plastic objects are found in increasing numbers in museum and archival collections, in works of modern art, archival materials and social history artefacts. However, they are among the most vulnerable objects in collections due partly to inherent instability in some historical formulations, and also due to a lack of knowledge of best conservation practice: while there have been substantial advances in the field in the last 25 years, there is still a need for new ways of identifying vulnerable artefacts or choosing optimal storage and display conditions.

The aim of this project is to explore a new way of understanding the degradation of plastics, using system dynamics. System dynamics explores inter-relationships between different processes within a complex system, aiming to understand and change the system's behaviour. Plastic objects will be viewed in this way so that multiple chemical and physical degradation processes can be better understood. This is both a new approach to studying material degradation with potential for wider applications in fields such as medicine and an approach that can yield practical solutions for heritage professionals working with plastic objects in collections.

The SEAHA student for this project will work with other students and postdoctoral researchers as part of *COMPLEX,* including those with expertise in mathematical modelling and chemistry.

The project addresses the following research questions:

1. How have the chemical and physical processes governing degradation of plastic objects in collections been defined and studied within existing literature? How can these be combined as part of a system dynamics model?
2. What relevant processes are currently poorly defined? How can these be explored experimentally, understood and defined in more depth and incorporated into a system dynamics model?
3. What is the variation in the composition and condition of plastic objects in collections and how do the environments in which they are stored and displayed vary?
4. How do degradation processes vary between different objects or scenarios such as different storage temperatures or display lighting conditions? How can this variation be understood in more depth and incorporated into a system dynamics model?

In the initial MRes phase, the successful candidate will first undertake a literature review. They will also conduct on-site analysis of museum objects using non-destructive techniques and visual observation to

study variation in composition and evidence of degradation. They will conduct an in-depth exploration of a particular degradation process (focussing first on a single polymer, likely cellulose acetate), identified as a priority during the literature review. Working with the more modelling focussed researchers in COMPLEX, experimentally and theoretically derived mathematical equations for these processes will be developed, which can then be incorporated into a developing system dynamics model. The research will involve the use of many analytical techniques for understanding material composition and degradation, including Fourier Transform Infrared (FTIR) and Near Infrared (NIR) spectroscopies, gas chromatography/mass spectrometry (GC/MS), scanning electron microscopy (SEM), Differential Scanning Calorimetry (DSC), Dynamic Mechanical Analysis (DMA), X-ray Photoelectron spectroscopy (XPS), colorimetry and X-ray Fluorescence (XRF). These will be used both as destructive analytical techniques on sacrificial plastic samples and where possible, as non-destructive techniques for the analysis of artefacts on-site.

During the PhD phase, the student will expand this study to a wider range of degradation processes, and to a wider range of plastic materials. This will involve: (1) Identifying degradation processes that are currently poorly defined within the literature and designing experiments to better understand and define them. (2) Designing and carrying out experiments to better understand the range of values that exist for key material parameters e.g. diffusion coefficients. (3) Conducting onsite analysis in museum storage and display facilities, using non-destructive analytical techniques to understand material composition and condition and to monitor environmental conditions (4) Developing methods of validating the system dynamics model.

Academic entry criteria: The candidate will ideally have a background in Chemistry, Material Science or a related field.

Training path: The student will be part of the EPSRC Centre for Doctoral Training SEAHA (Science and Engineering for Arts, Heritage and Archaeology). Students will register for the one year MRes SEAHA at UCL in year 1 and then continue to PhD studies for years 2-4 of the studentship. The student will be encouraged to spend time working at both the Museum of London and Lacerta Technology Ltd.

Funding: The SEAHA Studentship will cover fees for both UK and EU students and a stipend of up to a maximum of £18,172 per year (current rate) for eligible applicants including budget for research, travel, and cohort activities. Non-EU applicants are not eligible for funding.

Enquiries: Please contact the academic supervisor for further information (k.curran@ucl.ac.uk)

Application Deadline: 20th August 2017 5pm GMT

How to apply:

Your application should include:

- A substantial covering letter (2-3 pages) including:
  - a clear explanation of your motivation for applying for this project
  - a statement of your understanding of your eligibility according to criteria specified by SEAHA and the EPSRC.
- A short research proposal (max. 2000 words) taking into consideration the project research questions
- A full CV
- Contact details for two academic references (names, postal and email addresses)
- Proof of meeting the UCL English language proficiency requirements where necessary. For SEAHA candidates, an advanced level certificate is normally required. See UCL's English language requirements page for further details.

Interviews are likely to take place in late August. Please mention in your covering letter if you will not be available at this time. Remote interviews (e.g. via skype) are possible if necessary.

Apply: the application should be submitted by email directly to the UCL SEAHA Manager and not via the UCL online admissions system. Please email applications to: SEAHA Centre Manager, manager@seaha-cdt.ac.uk