# OXFORD SIGMA JOB DESCRIPTION

16th January 2025

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| Job title: | Engineering Intern |
| Job location: | Oxford City Centre, UK |
| Hours: | Full-time (37.5 hours per week) |
| Salary: | £25,065 (pro-rata) |
| Dates: | Starts July 2025 (8-week placement) |
| References, by project: | OS-JA-INTERN-25-A<br>OS-JA-INTERN-25-B<br>OS-JA-INTERN-25-C<br>OS-JA-INTERN-25-D |

## Company

**Our vision** is to tackle energy security and climate change by accelerating the commercialisation of fusion energy. **Our mission** is to deliver materials technology, materials solutions, and fusion design services in order to assist fusion delivery.

**About us**: We are a small, organically grown, company owned and operated by scientists and engineers, with our roots and headquarters in Oxford. We have established ourselves as a highly respected technical service supplier for the fusion energy market, within both the private and public sectors, nationally and internationally. We are equally a research and technology development company developing novel disruptive materials and design technologies to help in the required fundamental shift for the world's clean energy future.

This internship is in collaboration with the UKAEA through the Fusion Industry Programme (FIP). The FIP targets the third pillar of the UK's Fusion Strategy, which is "commercial leadership via thriving private-sector innovation and technology transfer". A key element to achieving this is to attract and retain a diverse range of talented people working within the fusion industry. The FIP includes an Education Scheme which aims to increase the supply of highly skilled students and researchers into the sector.

UK Atomic Energy Authority

This internship position at Oxford Sigma is part of the Summer Placement Scheme and which enables students to undertake paid placements within host organisations related to the fusion industry.

## Eligibility

The candidate must have the right to work in the UK
The candidate must be an Undergraduate, Postgraduate or PhD student who is still classified by their university as a student at time of placement start.

## Apply

We'd love to understand more about you, and why you want to get involved in fusion.
Submit your CV and covering letter (both in PDF format) at www.oxfordsigma.com/careers/
Applications will be reviewed fortnightly, until all our spaces are filled, or until **17:00 31st March 2025** – whichever comes first.

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**Projects**

## DEVELOPMENT OF SELF-HEALING MATERIAL IN HIGH-TEMPERATURE ENVIRONMENTS

Reference: OS-JA-INTERN-25-A

Cracking in metals due to thermal loads causes loss of conductivity, leading to the formation of hotspots that can trigger the liquefaction of a low melting point secondary phase which has the potential of filling in the crack, restoring contact and thermal conductivity i.e. self-healing.

This project consists of a literature review looking into self-healing metals in high-temperature applications (e.g. heat exchangers for fusion or otherwise), understanding suitable systems (investigation of the phase diagram and solubility) and joining techniques and interface reactions, as well as the development of a modelling tool to predict material performance in high temperature environments. This will culminate in a draft of review paper on self-healing material in a heat exchanger and proposal of design for self-healing component in a heat exchanger.

**Student Suitability**
Suitable for students studying materials science/engineering, mechanical engineering, physics, chemistry, and chemical engineering.

**Student Responsibilities**

- Be embedded into the Oxford Sigma materials team, being exposed to a range of projects.
- Perform a literature review of self-healing materials, including joining techniques and interface reactions.
- Identify potential applications for self-healing materials, in fusion or otherwise.
- Develop a modelling tool to predict material performance in high-temperature environments.
- Write up findings in a technical report.
- Present the output of the project to the wider Oxford Sigma team.

# DOWNSELECTION AND SUBSTANTIATION ROADMAP FOR MATERIALS IN LIQUID METAL ENVIRONMENTS IN FUSION

Reference: OS-JA-INTERN-25-B

Many fusion energy device designs, both in the UK and worldwide, are proposing the use of liquid metals in the breeder blanket component. This presents several challenges, including the substantiation of designs in which a corrosive liquid metal is in contact with structural material. Through independent investigation and arranged consultation with industry experts at Oxford Sigma and other organisations, you will define, collate, prioritise, and cost the activities which will be necessary to substantiate and operate such a design. By creating an adjustable excel model of these activities, the cost and quantity of certain activities may be adjusted at a later date to suit the specific needs of an operator.

You will collect and present your findings in a draft of a journal article for peer review which will be submitted for publication for the benefit of the industry. As a stretch objective, you will prepare a training pack targeted at informed – but not expert – staff who may wish to make use of the substantiation pathway which they have identified.

**Student Suitability**
Suitable for students studying materials science/engineering, mechanical engineering, physics, chemistry, and chemical engineering.

**Student responsibilities**

- Be embedded into the Oxford Sigma team, being exposed to a range of projects.
- Engage with internal and external experts to understand the materials substantiation process, and the work already done in this space.
- Define and prioritise the necessary activities for substantiation of materials in liquid metal environments, producing a roadmap for substantiation.
- Produce a cost model for substantiation activities.
- Write up the roadmap into a journal article format.
- Present the output of the project to the wider Oxford Sigma team.

**THE ECONOMICS OF COMMERCIAL FUSION**

Reference: OS-JA-INTERN-25-C

You will gain understanding of the basic figures of merit used to determine the economics of energy (LCOE, LACE, etc.) and calculate these values for fusion by referencing those of early-generation fission as well as first-principle calculations of the labour, overhead, raw materials, construction, operation, maintenance, and decommissioning cost of a fusion power plant. Specific levelised costs will be calculated using methods previously utilised by UK DENZ and the Nuclear Industry Association and projections of how these values can change depending on different scenarios will be made.

The project will culminate in a report that walks the readers through the economics of fusion energy, incorporating short case studies, graphs, numerical tables, and comments on existing reports on this topic with a stretch goal to develop a spreadsheet allowing the user to input high level parameters (i.e. reactor type, power output, basic materials) and be provided with a cost estimate for said design.

**Student Suitability**
Suitable for students studying a STEM subject.

**Student Responsibilities**

- Be embedded into the Oxford Sigma team, being exposed to a range of projects.
- Perform a review into the economics of commercial fission and fusion energy, including levelised cost of energy (LCOE) and levelised avoided cost of electricity (LACE).
- Develop a tool to provide high level cost estimates for the construction of a fusion power plant.
- Write up findings in a technical report.
- Present the output of the project to the wider Oxford Sigma team.

**UPGRADING A LIQUID METAL LOOP TO INCLUDE MAGNETOHYDRODYNAMIC (MHD) TESTING FOR VALIDATION OF MODELLING TOOLS**

Reference: OS-JA-INTERN-25-D

During the design of Oxford Sigma's liquid lithium loop (LiFTOFF), opportunities for improvement (such as implementing a recuperator) have been identified. There is also a drive to extend the testing capabilities of LiFTOFF to include MHD (magnetohydrodynamic) testing for validation of existing and future MHD modelling tools.

The main objective for the internship project is to create an initial concept level CAD of an upgraded LiFTOFF loop, including an MHD testing module and other upgrades suggested by Oxford Sigma.

During the project, you will learn about the design and operation of liquid metal loops and how they can help advance fusion energy by reviewing the design of LiFTOFF and learning about the suggested improvements to it. You will conduct a literature review of tools and equipment required for MHD experiments, learning about how testing that captures 3D MHD effects is an essential step in validating MHD models which will inform the design of future fusion power plants.

This knowledge will be used to implement upgrades into the existing LiFTOFF CAD and to design a MHD testing module, along with a plan for integrating the module into LiFTOFF. This plan will include the measuring tools required to capture 3D MHD effects, where this equipment could be procured and how it could be implemented into LiFTOFF.

**Student Suitability**
Suitable for students studying materials science/engineering, mechanical engineering, and chemical engineering.

**Student responsibilities**

- Be embedded into the Oxford Sigma team, exposed to a range of projects.
- Engage with the LiFTOFF project team to understand the design, rationale, and potential future improvements.
- Perform a literature review of existing liquid metal test facilities, including MHD capability.
- Generate requirements for an MHD testing module, understand its interfaces with the system.
- Produce a concept level CAD design of a MHD testing module.
- Present the output of the project to the wider Oxford Sigma team.

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