

New Single-Molecule Tools to Study Self-Assembly

Supervisor: Joe Beckwith, joseph.beckwith@warwick.ac.uk. Please contact for informal enquiries.

Research Summary

Proteins rarely work alone. They assemble into complexes, and the order in which they come together can decide whether a cell sends a signal or forms a toxic aggregate. That order is almost impossible to see with bulk methods, which average over millions of molecules. We have developed a microscope (preprint) that records both the position *and* the spectral fingerprint of individual molecules, letting us tell many molecules apart at once. In this project, you'll build the next generation of this instrument and use it to watch complexes assemble, one molecule at a time.

This will involve:

- Building a new single-molecule microscope.
 - You'll learn instrument design, electronics and programming for instrument automation as well as mechanical construction.
- Designing and implementing single-molecule imaging experiments.
 - You will learn, data (and image) analysis, numerical simulation, and chemical dynamics analyses.
- Imaging self-assembly in model systems and cells.
 - You will learn cell culture, as well as biophysical sample preparation.

This next generation instrument will then be applied to the earliest stages of T-cell activation: a three-part protein complex assembly that governs how our adaptive immune system responds to threats.

Why this group?

You'll be the first PhD student in a newly established group in Warwick Chemistry. That means hands-on supervision and a real say in how the lab and its work takes shape. Joe recently co-developed the spatial-spectral microscope this project builds on, work that is now the subject of a patent application. For more information on the lab, please see jsbeckwith-lab.com.

The group sits at the interface of physical chemistry and biophysics. Alongside immune signalling, we use photothermal and single-molecule methods to study how nanoparticles form. You'll also benefit from our collaborations with groups in Göttingen, Geneva and Durham and links outside academia, giving you a wide network and experience.

Funding Notes

This studentship (3.5 years) is funded by UKRI, covering a stipend and tuition fees, for a UK student, at the UKRI rate. Please contact Joe for further details.

Start Date

October 2027

Application Deadline

31 January 2027

Eligibility

We welcome applications from all suitably qualified candidates, and particularly encourage applications from under-represented groups. We are seeking someone who enjoys building things, physical chemistry, coding, and taking apparatus apart. Applicants should hold, or expect to obtain, a strong undergraduate degree in Chemistry, Physics or a related discipline by the start of the project.

How to apply

Please apply via the university's online portal at <https://warwick.ac.uk/study/postgraduate/apply/> .