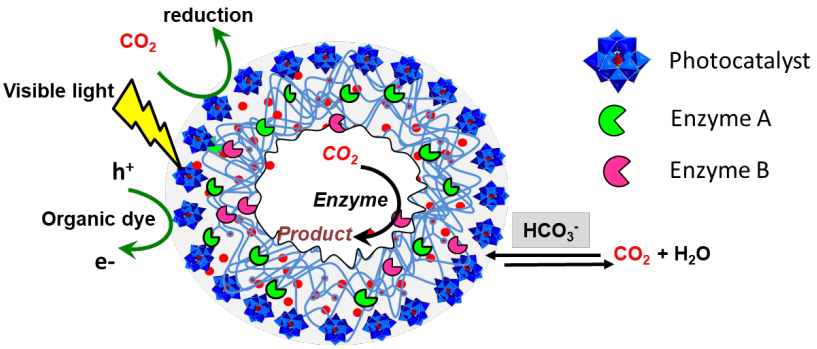
Construction of multi-catalytic protocells for effective CO_2 fixation and conversion

About the project or challenge area: The rapid growth of carbon dioxide (CO_2) in the environment due to anthropogenic activity has resulted in increasing global warming and climate change. Hence, there is a constant quest to develop new methods and technologies to reduce the levels of CO_2. Significantly, plants and a few bacteria utilize CO_2 in photosynthesis and produce glucose as a source of energy. However, the natural CO_2 fixation is too slow as a process to fix all the environmental CO_2. One new area where colloidal-scale structures could make a significant breakthrough is in the formation of artificial-cell-like materials (protocells). Much of the inspiration for this approach comes from mimicking key aspects of the living cells, albeit with a large degree of simplification. This project aims to utilize functional biotic (enzymes) and abiotic (catalytic inorganic nanoparticles) components for the construction of programmable protocell architectures (multi-catalytic reactors***, see the schematic below***) and handlable devices for applications in CO_2 fixation and environmental remediation. Overall, design and construction of new affordable materials with small-scale structures and biomimetic properties is expected to be of great importance in wide-ranging applications such as sensing, storage and release, and controlled catalysis.

Why choose this opportunity? The focus of your project will be on synthesis of functional inorganic nanoparticles, bio/photocatalysis and microfabrication technologies which will provide an excellent platform to learn about the design of functional materials at various length scales and their practical applications. Your work in this area can make a real impact on global challenges, such as multi-catalytic compartmentalized colloidal-scale objects for energy storage, carbon fixation, water splitting, health and personal care and advanced composite micro-engineering. You will develop and increase your expertise in broad chemical synthesis and characterization techniques, whilst becoming familiar with the fundamentals of nanomaterials, self-assembly and bio-/photocatalysis. Furthermore, this project will require your collaboration with other members across other research groups, thus improving your teamwork and networking skills. You will also develop a range of transferable skills, including presentation, scientific writing, and project and time management. Finally, you will be interacting with students from all over the world learning from their culture and skills, adding to your professional and personal development.



Full training will be provided for all aspects of this project. You will be embedded in the Supervisor's research group, who will provide support. In addition, you will be assigned a mentor for the duration of your project, who will provide extra support and help you to identify any additional training needs or opportunities.

About you: Ideally you will already have skills and knowledge in general preparative chemistry, teamwork and time management.

Bench fees: A bench fee of £7000 is required.

How to apply: Applications are accepted throughout the Academic Year, and you should complete the online application form for Chemistry (MSc by Research).

Supervisor: Your supervisor for this project will be **Dr Avinash Patil**, in the School of Chemistry. You can contact him at +44 (0) 117 3317215 or email avinash.patil@bristol.ac.uk

Find out more about your prospective research program: This paper explains the design and construction of catalytic protocells. https://www.nature.com/articles/s41467-019-13759-1