Tackling antibiotic resistance by combining synthetic biology and nanotechnology: development of new biosensing systems

Supervisory team:
Main supervisor: Dr Dafydd Jones (Cardiff University)
Second supervisor: Dr Martin Elliott (Cardiff University)
Prof Emyr Macdonald (Cardiff University)

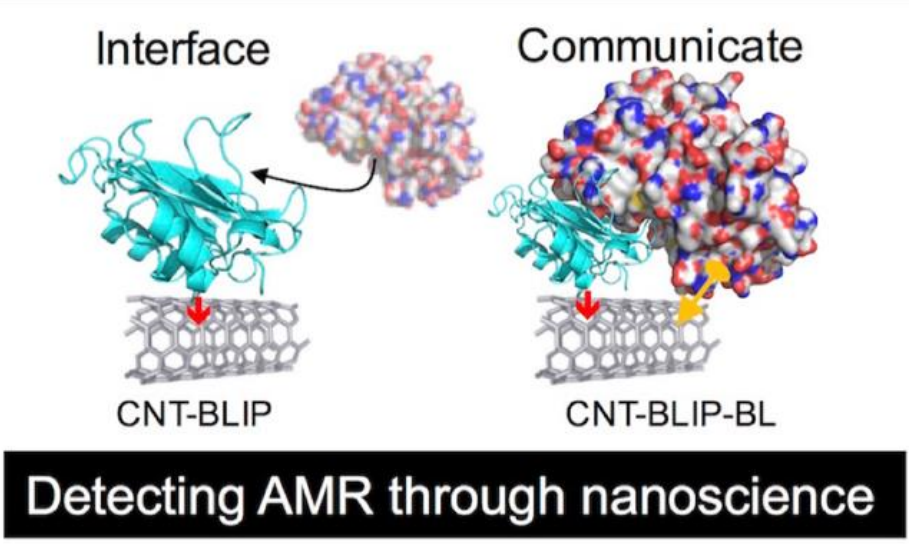
Collaborators: Prof Servio Russo (University of Exeter), Prof Monica Craciun (University of Exeter), Dr Aravind Vijayaraghavan (University of Manchester)

Host institution: Cardiff University

Project description:

The project provides a student with the opportunity to bridge the areas of synthetic biology and nanotechnology to address one of the most important areas of research: the growing problem of antimicrobial resistance (AMR). Bacterial resistance to antibiotics is one of the most significant crises in modern healthcare. The most widely utilised class of antibiotics (and therapeutics in general) are the beta-lactams, which include ampicillin, amoxicillin and methicillin. By far the main mechanism bacteria use to confer beta-lactam resistance is the production of beta-lactamases (BLs) that inactivate the antibiotic and thus removing its therapeutic value. A gap in modern antimicrobial treatment is a companion diagnostic for improving antibiotic use based on detecting the presence of key AMR markers. Your studentship will take a vital step towards filling this gap by combining synthetic biology with nanotechnology to generate a new detection system. You will link environmentally sensitive electronic materials to the unique molecular signatures of AMR proteins. To achieve this you will engineer a protein called BLIP that binds to a wide variety of BLs so that it can interface precisely with the base sensing material, carbon nanotubes (CNTs). CNTs are incredibly useful sensing materials as their electrical conductance is highly sensitive and changes in response to local changes in environment such as protein-protein interactions. To generate the precise interface between BLIP and CNTs, you will use an exciting new synthetic biology approach. By reprogramming the genetic code, you will introduce new chemistry types not present in nature into BLIP that will facilitate the interface with CNTs. You will thus be involved in developing a new approach to biomolecular sensing with resolution down to the single/few molecule level.

You will learn a variety of techniques that span different disciplines, ranging from protein engineering, reprogrammed genetic code approaches, material interfacing, single molecule imaging amongst others.


Interface
Communicate
CNT-BLIP
CNT-BLIP-BL
Detecting AMR through nanoscience