AIBN Master Projects | Dr Run Zhang and Professor Gordon Xu

https://aibn.uq.edu.au/profile/2577/run-zhang

https://aibn.uq.edu.au/profile/2223/gordon-xu

Responsive nanoprobe for redox monitoring in inflammation

Description

Inflammation happens when the body's immune systems respond to the harmful stimuli, such as infections, injuries, and toxins. Typically, elevated level of reactive species, including reaction oxygen species and reactive nitrogen species, are associated with the inflammatory diseases. Therefore, quantitative detection of these biomolecule levels promises both early diagnosis and in situ monitoring of inflammatory pathologies and redox-targeted therapy, potentially advancing future clinical care of patients with inflammatory diseases. In this context, the project aims to develop non-invasive responsive nanoprobes for redox biomolecules detection in inflamed cells and tissues.

Expected outcomes and deliverables

This project involves the design, preparation, and characterization of the responsive nanoprobes. Biological studies of the redox biomolecules quantification in living cells and organisms are also included. It has the capacity to further promote to a PhD project and has strong publication potential.

Required experience

This project is open to applications from self-motivated students with a background in Chemistry, Biochemistry and Biotechnology, Nanotechnology. Master and Honour student with 1-year full-time research project are preferable.

Contact the project advisor directly to discuss the project and arrange a meeting or AIBN Events (aibn.events@uq.edu.au) to arrange a visit to the AIBN lab.

Contact Information

Dr Run Zhang
r.zhang@uq.edu.au
(07) 3346 3806

Professor Gordon Xu
gordonxu@uq.edu.au
(07) 334 63809

AIBN Master Projects | Dr Li Li and Professor Gordon Xu

https://aibn.uq.edu.au/profile/2571/li-li

https://aibn.uq.edu.au/profile/2223/gordon-xu

Nano-formulations in feed for livestock disease management

Description

With the rapid increase in population and economy, the demand for food has increased dramatically. The use of antibiotics to control bacterial and virus diseases is restricted in the livestock. Vaccination is widely used to manage livestock diseases in farm industry. However, most commercial vaccines are injected subcutaneously, which causes stress of the animals and cross-infections, makes vaccination difficult for your stock with insensitive manpower. Oral vaccination with antigen included in feed would be the ideal method for vaccination, especially for poultry and fish. In this project, we aim to develop effective nano-formulations encapsulated with antigens in animal feed to protect livestock from disease such as poultry and fish.

Expected outcomes and deliverables

This project involves synthesis and characterization of nanoplatforms for vaccine delivery and investigation of the mechanism of oral delivery systems in the guts. Students can learn the relevant knowledge in nanomaterial preparation and characterisation as well as experimental skills in cell culture. Students have an opportunity to generate publications from their research output and this project has capacity to be a PhD project: 1) Co-authorship in future publications; 2) continuation as an Honours/Masters/PhD research project.

Contact the project advisor directly to discuss the project and arrange a meeting or AIBN Events (aibn.events@uq.edu.au) to arrange a visit to the AIBN lab.

Contact Information

Dr Li Li
l.li2@uq.edu.au
(07) 3346 3806

Professor Gordon Xu
gordonxu@uq.edu.au
(07) 334 63809

AIBN Master Projects | Dr Li Li and Professor Gordon Xu

https://aibn.uq.edu.au/profile/2571/li-li

https://aibn.uq.edu.au/profile/2223/gordon-xu

Development of a novel nano-emulsion platform for targeted delivery

Description

Cancer is one of the world's most devastating diseases, with more than 10 million new cases every year. Chemotherapy has been used for cancer treatment in a clinic. However, application of these anticancer drugs is restricted by poor water solubility, erratic absorption and varying bioavailability. To overcome these problems, advanced drug delivery systems are needed. Therefore, this project aims to develop a conjugated nano-emulsion platform for targeted delivery of hydrophobic drugs to enhance the permeability and bioavailability of the drugs. The efficacy of cellular delivery will be investigated. Expected outcomes and deliverables

Expected outcomes and deliverables

This project involves synthesis and characterization of a conjugated nano-emulsion platform. The students are expected to master various preparation methods and characterization techniques and cell analysis techniques. It has capacity to grow into an PhD project and has a publication potential

Required experience

This project is suitable for students with Chemistry, Science, Biomedical Science, Chemical Engineering, Biochemistry and Biotechnology.

Contact the project advisor directly to discuss the project and arrange a meeting or AIBN Events (aibn.events@uq.edu.au) to arrange a visit to the AIBN lab.

Contact Information

Dr Li Li
l.li2@uq.edu.au
(07) 3346 3806

Professor Gordon Xu
gordonxu@uq.edu.au
(07) 334 63809

AIBN Master Projects | Professor Gordon Xu and Dr Peng Li

https://aibn.uq.edu.au/profile/2792/peng-li

https://aibn.uq.edu.au/profile/2223/gordon-xu

Development of nanoparticle-loaded RNA vaccines for crop protection

Description

Global crop yields are estimated to be reduced by 30–40% per year because of plant pests and pathogens, constraining global food security. The current approaches to management of pests and diseases rely on plant genetic resistance and/or transgenes coupled with insecticide and fungicide sprays. The need for innovative approaches in managing crop health grows each year, driven by the need for greater production, climate-driven pest expansion, community and regulatory demands, toxicity issues and pesticide resistance. RNAi has emerged as a powerful strategy to engineer transgenic disease resistance against pests and pathogens in plants. Topical application of dsRNA for pest control is emerging as an appealing alternative to genetically modified crops. However, a major limitation in the practical application of dsRNA as a spray is a short virus protection window of 5–7 days post spray.

In a world's first, we have demonstrated the proof of concept of nanoclay-loaded RNA as a stable spray application for sustained crop protection for 30 days, negating conventional transgenic approaches. This project aims to contribute in taking the outcome to the stage of market-ready products.

Expected outcomes and deliverables

This project involves preparation and characterisation of synthetic nanoclay and formation of nanoclay-RNA platform. The student is expected to understand the mechanism of crystal growth, master various characterisation methods and cell analysis techniques, and approach contact with industry. It has the capacity to further promote to a PhD candidature and publication potential in top class journals.

Required experience

This project is suitable for students with the background of chemistry, materials sciences, chemical engineering, biotechnology, biochemistry, and crop science. The student will be expected to conduct full-time research in AIBN.

Reference

Mitter et al., Clay nanosheets for topical delivery of RNAi for sustained protection against plant viruses, Nature plants, 2017, 3: 16207

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Contact Information

Dr Peng Li
p.li3@uq.edu.au
(07) 3346 3806

Professor Gordon Xu
gordonxu@uq.edu.au
(07) 334 63809