THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Professor Chunxia Zhao

Phone: 3346 4263

Email: z.chunxia@uq.edu.au

Precision-engineered hybrid core-shell materials for drug delivery

Name of Supervisor: Chun-Xia Zhao, Amy Liu

Poor water solubility of many chemical actives hinders the development of new pharmaceutical, agricultural, food products. For example, 40% of approved drugs and 90% of drugs in development are water-insoluble. New methods are needed for more efficient formulation and delivery of these drugs. This research will develop new platform technologies for making hybrid core-shell materials with exceptionally high drug loading capacity and programmed drug release, delivering new technologies for the manufacture of high-value pharmaceutical products. The novel core-shell materials will enable more efficient delivery of hydrophobic ingredients, and place Australia at the forefront of nanotechnology and drug delivery research. The future applications of these materials in a wide variety of fields, such as pharmaceuticals (controlled release of drugs), and agriculture (sustained release of hydrophobic insecticides, plant protection agents and fertiliser) may lead in the longer term to considerable economic and social benefits.

Development of novel bio-inspired biomolecules for controlling colloidal stability

Name of Supervisor: Chun-Xia Zhao, Daniel Yang

Short one paragraph abstract: This project aims to design biomolecules (peptides and proteins) for controlling the stability of colloid particles. A series of biomolecules (peptides and proteins) will be designed to have different structures and surface activity. Peptides will be synthesised using chemical methods, while proteins will be expressed in E. Coli and produced using a simple chromatography-free separation method. The interactions between these designed biomolecules and colloid particles with different charge, size and hydrophobicity will be systematically studied using a variety of techniques including settling tests, depletion adsorption isotherms, turbidity measurements, atomic force microscopy, zeta-potential, dynamic light scattering and scanning electron microscopy. These designed biomolecules along with the fundamental understanding of their interactions with colloid particles will improve handling and processing of particles suspensions for various applications in mineral processing, water purification, wastewater and sewage treatment, etc.

Name of Honours Project: Stimuli-responsive soft materials based on biomolecules

Name of Supervisor: Chun-Xia Zhao, Daniel Yang

Short one paragraph abstract: This project aims to develop stimuli-responsive soft materials (foams and emulsions) using designed biomolecules (proteins and peptides). Peptides or proteins are informational polymers made up of amino acids and are increasingly viewed as key building blocks to achieve specific functions owing to their biocompatibility, sustainability, and ease of functionalization, coupled with facile methods for their economic manufacture. Enabled by the diversity of the 20 naturally occurring amino acids, there is a large sequence and structural solution space for design.

This work aims to explore the functionality of using biomolecules to stabilise foams or emulsions, and the potential for switching that functionality based on different switching mechanisms. This study seeks to develop the functionality offered by biomolecules such as peptides or proteins that change conformation when adsorbed to an interface in controlling the nature of foams, emulsions, and flocculated suspensions. The designed biomolecules as well as the developed soft materials have great potential in a wide range of applications in mineral processing, pharmaceuticals, food industry, agriculture, etc.