ARC Centre of Excellence in
CONVERGENT
BIO-NANO SCIENCE
& TECHNOLOGY

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Signature Projects

Our CBNS Signature Projects draw on the capabilities of our expert researchers to solve the big questions in bio-nano research.

MEDIATING PROTEIN INTERACTIONS

Leaders: Dr Pu-Chun Ke, Professor Frank Caruso, Professor Pall Thordarson

Co-Leaders: Dr Yi (David) Ju, Ms Emily Pilkington, Dr Adam Martin

THE PROJECT

We aim to develop strategies for controlling protein and peptide structure and aggregation, and understand which biological signals are important to sustain and promote cell growth in biomaterials based on peptides and proteins. Central to these aims is to better understand the mechanism that underpins protein and peptide self-assembly, folding, and misfolding. The knowledge obtained from this work will be essential for developing more effective strategies against amyloid diseases and protein fouling, which will be the primary focus of this project.

THE BIG QUESTIONS

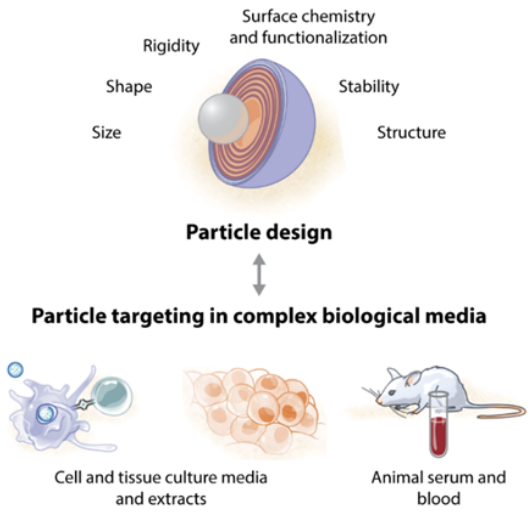
- How to modulate protein binding on particle surfaces through material engineering for improved delivery of nanomedicines?
- How does the toxicity of amyloid proteins evolve with their changing physicochemical properties and environments through fibrillation and corona formation?
- How to exploit the chirality of toxic amyloid proteins for their *in vivo* clearance and chiral nanoparticles?
- What are the mechanisms and implications of amyloid protein cross-talk (e.g. amyloid beta and amylin)?

The benefits of this research

- To provide key guidance to the design of stealth nanoparticles for nanomedicine.
- To develop theranostics against amyloid diseases.

Our goals

- To establish a synergetic, world-class team at CBNS, investigating the implications of nanoparticle-protein interactions in nanomedicine and amyloid diseases.
- To train next-generation bio-nano scientists and engineers.
- To facilitate domestic and international collaboration and exchange.

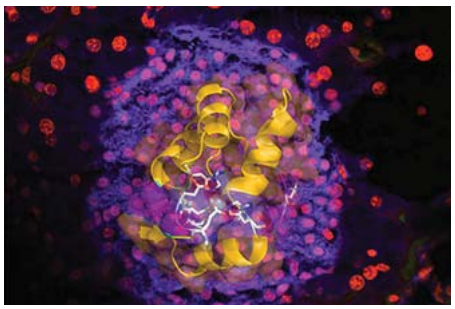


Particle properties and the biological environment influence particle targeting in complex biological media.

MEDIATING PROTEIN INTERACTIONS

Media highlights

- Advanced Science News; 2017.
- Front cover of Environmental Science: Nano; 2017.
- Front cover for Chemical Communications; 2017.
- Invited cover for Chemical Society Reviews; 2017.
- Front Cover of ACS Macro Letter; 2015.



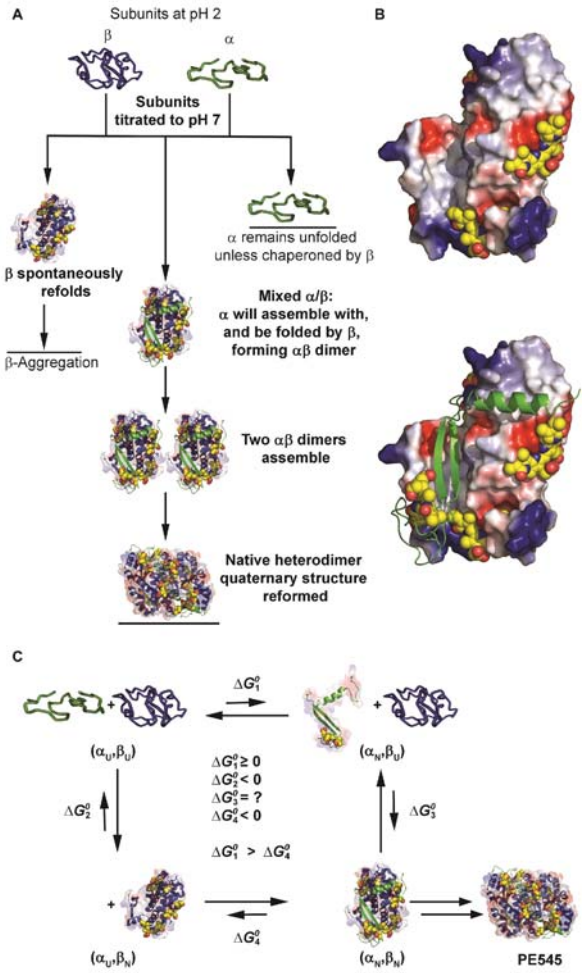
Peptide aggregation and stabilisation in human pancreatic islets.

Recent publications

- Implications of Peptide Assemblies in Amyloid Diseases; Chemical Society Reviews; DOI: 10.1039/c7cs00372b; 2017.
- Particle Targeting in Complex Biological Media; Advanced Healthcare Materials; DOI: 201700575R1; 2017 (invited review).
- Cooperative Subunit Refolding of a Light-harvesting Protein through a Self-chaperone Mechanism; Angewandte Chemie International Edition; 56, 8384-8388; 2017.
- Cell-Conditioned Protein Coronas on Engineered Particles Influence Immune Responses; Biomacromolecules; 18, 431; 2017.
- Monoclonal Antibody-Functionalized Multilayered Particles: Targeting Cancer Cells in the Presence of Protein Coronas; ACS Nano; 9, 2876; 2015.

Signature Project collaborations: Mediating protein interactions

Institution	Collaborator
University of Warwick	Professor David Haddleton Professor Greg Challis
University College, Dublin	Professor Kenneth Dawson
University of Nottingham	Professor Morgan Alexander
ETH Zurich	Professor Raffaelle Mezzenga
Clemson University	Professor Feng Ding
Monash University	Dr Darren Creek
University of Queensland	Dr Paul Wilson
Tongji University	Professor Sijie Lin
University of New South Wales	Professor Paul Curmi Professor Lars Ittner
University of Melbourne	Professor Frances Separovic Dr Esteban Gurzov
University of Western Australia	Professor Killugudi Swaminatha Iyer
Royal Perth Hospital burns unit	Professor Fiona Wood



The thermodynamic cycle for subunit folding leading to the formation of the folded abmonomers starting from the unfolded α- and β-subunits (αU, βU).