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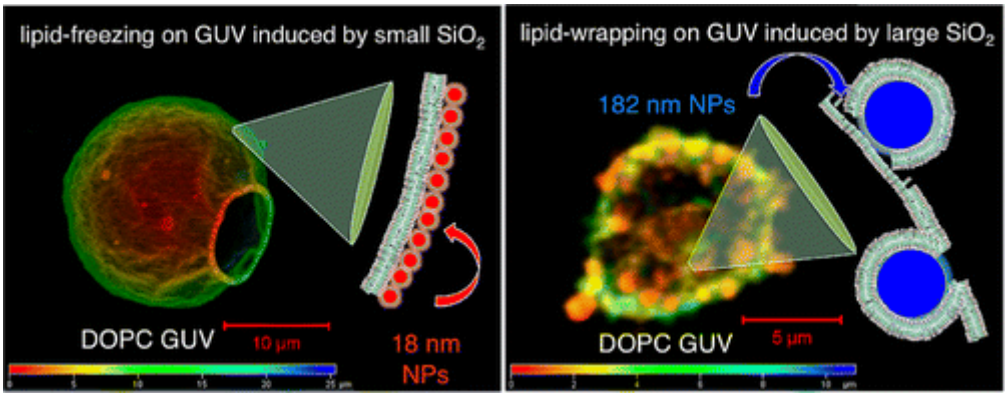
Membrane biophysics approaches to investigating the potential toxicity of engineered nanoparticles

The purpose of this project is to study the interactions of synthetic nanoparticles with model biomembranes to understand the physical perturbations they cause to membrane structural properties and how these may lead to toxic responses in cells or advantageous properties for drug delivery.

New materials offer the prospect of exciting new technologies but also carry the risk of presenting new health hazards. One such class of new materials that presents exciting new technological prospects as well as considerable potential health risks are engineered nanomaterials.



This project will use advanced biophysical methods to investiagate the interactions of nanoparticles with reconstituted model biomembranes in the form of giant unilamellar vesicles (GUVs). GUVs are micro-scale, unsupported spherical lipid bilayers and hence have a similar structure to the membranes of natural cells. We will use optical microscopy techniques to monitor dynamic changes in membrane morphology (1,2), quantify changes in membrane permeability (3) and measure intra-membrane lipid dynamics in response to external nanoparticulate stimuli (4). We will assess how the response of these membranes depends upon their lipid composition, the physical properties of the nanoparticles and other physicochemical properties of the biomembrane's environment (e.g. pH, salt concentration, presence of serum proteins, etc.) that impact upon the outcomes of these interactions.

In this way we aim to understand the detailed mechanisms by which these nanomaterials interact with biological membranes. This will reveal possible mechanisms for cellular uptake and/or damage, suggesting potentially nanoparticle toxicity or revealing auspicious properties that might be utilised in drug delivery applications or diagnostic imaging.

This multidisciplinary project will provide opportunities for the student to receive training in membrane biophysics, advanced optical imaging techniques and nano-characterisation.

Please contact Dr Paul Beales (p.a.beales@leeds.ac.uk) for further details about this opportunity.

References

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