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Interfacial Structure of Tailorable Nanocarrier Emulsions: X-ray and Neutron Scattering Approaches.

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The oil/water interface is crucial to many industrial systems, for example emulsions (food, cosmetics, drug delivery and others), chemical extraction (both aqueous to organic and the subsequent back extraction). Tailorable nanocarrier emulsions (TNEs) are a novel class of oil-in-water emulsions stabilised by molecularly-engineered biosurfactants that permit single-pot stepwise surface modification with related polypeptides that may be chemically conjugated or genetically fused to biofunctional moieties. The interfacial properties of such materials particularly when one component is on the nanoscale have a profound influence on biodistribution and stability as well as the effectiveness of sophisticated surface-encoded properties such as active targeting to cell surface receptors.

The target droplet size for the TNE is in the 100 -200 nm range with low polydispersity. Molecular scale characterisation of the liquid/liquid interface in such systems is challenging. It is nonetheless of prime importance in a variety of physico-chemical-biological areas both fundamentally and practically. We have simplified the approach to this system by beginning with x-ray and neutron scattering methodolgies to studying the structure and molecular conformation at planar oil/water interfaces.

I will discuss our current work on related to TNEs for drug delivery. The TNEs consist of an oil in water emulsion where the interface is stabilised by a rationally designed single alpha helix peptide (AM1). To the AM1 stabilised emulsion a related four-helix peptide (DAMP4) is added. The DAMP4 can be linked to a range of biologically functional elements including antibodies or protein resistant molecules. The arrangement of the AM1 and DAMP4 at the oil/water interface and competition between the two species are important questions, the answers to which help to guide the TNE design. Furthermore, the presentation, conformation and orientation of the antibody into the aqueous phase impacts upon the TNE design and ultimately activity.

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