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Australian Centre for Neutron Scattering (ACNS)

Bilby

Time-of-Flight Small Angle Neutron Scattering

Bilby is well suited for mainstream and classic complex SANS experiments as well as for the study of kinetic effects, like relaxation following a chemical reaction, or external impulses like mechanical deformation, an electric or magnetic field.

Small angle scattering

By studying the way in which radiation is elastically scattered by a sample at small-angles, it is possible to determine the size, shape and preferred orientation of nanoscale structures within a sample.

What makes Bilby special?

By utilising neutron time-of-flight it is possible to investigate a large number of length scales in a single experiment, that is not possible on conventional monochromatic style instruments. The large dynamic Q-range of Bilby makes it ideal for studying a diverse range of materials from minerals to membranes, and it opens up the possibility of studying the kinetics of structural changes.

If needed, monochromatic set-up is also available to use by request.

Applications

Small Angle Neutron Scattering can provide valuable information in a wide variety of scientific and technological applications including:

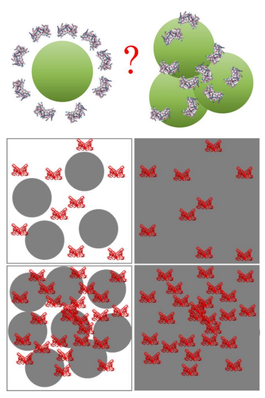
- Surfactants, colloids and polymers
- Biological macromolecules (including proteins, DNA/RNA and viruses)
- Biological membranes
- Defects/pores in materials
- Ferromagnetic correlations in magnetism
- Alloy segregation

CASE STUDIES

Polystyrene nanoplastics with protein corona

With the significant amount of plastic waste in the environment, there is concern that the environmental concentration of polymeric nanoplastics will increase considerably in the future, due to the natural weathering and biodegradation of bulk plastic. Engineered nanoparticles are designed to minimize the risk to health for intentional uses in humans.

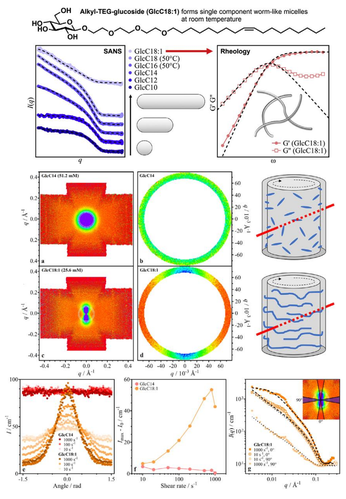
Upon contact with biological fluids, the surface of nanoparticles is surrounded by many types of proteins, forming a so-called “protein corona”. The physicochemical properties of the nanoparticle/corona complex depend predominantly on the nature of the protein corona. An understanding of the structure of the corona and the resulting complex provides insight into the structure−activity relationship. For more information see S.Kihara et al, *Bioconjugate Chem.* 2019 (30), 1067−1076.



Surfactants

Carbohydrates are appealing non-ionic surfactant head-groups as they are naturally abundant, generally biocompatible and biodegradable, and readily functionalized. Here, seven novel carbohydrate based surfactants (CBS) have been synthesized that contain a tri-ethylene glycol (TEG) linker between a glucose head-group and alkyl tail-group, with linear saturated (C8–18) and unsaturated (C18:1) alkyl chains. The aqueous adsorption and self-assembly of these surfactants was explored using tensiometry and small- and ultra-small-angle neutron scattering (SANS and USANS).

The room temperature worm-like micelles were further characterized using rheo-SANS and rheology. For more information see J.E.Moore et al, *Journal of Colloid and Interface Science*, 2018 (529), 464-475.



SPECIFICATIONS

Time-of-Flight instrument (choppers as a neutron filter) with the option of using monochromatic beam (velocity selector as a filter)

Wavelength range:
2-20 Å

Wavelength resolution:
3-30% (ToF), 10% (monochromatic)

Guide dimensions upstream collimator:
100mm x 40mm

Number of removeable guide sections in collimator:
8; 2m length each

Cross-section of guides in collimator:
40mm x 40mm

Nominal specifications:

Q-range
ToF mode: 0.001 – 1.8 $Å^{-1}$
Monochromatic mode (at 6Å): 0.003 – 0.7 $Å^{-1}$

Maximum flux at sample position:
10^7 $n \cdot cm^2 \cdot s^{-1}$

Detectors:
^{3}He tube position sensitive
240 tubes, 8mm diameter each, arranged on six panel

Rear carriage:
square detector, total area 640mm x 640mm

Front carriage:
four panels/curtains, translatable in and out of the beam
320mm x 640mm each.

INSTRUMENT SCIENTISTS

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