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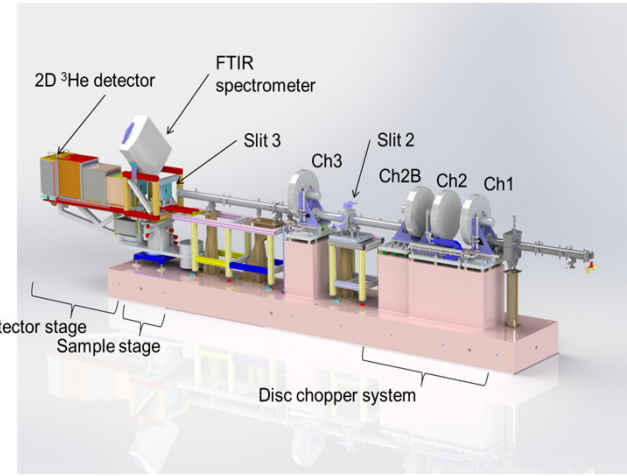
Australian Centre for Neutron Scattering (ACNS)

Spatz

Time-of-Flight Neutron Reflectometer

Spatz is well suited for the structural characterisation of surfaces and interfaces at the nanoscale. Typically, structures 10,000 times thinner than a sheet of A4 paper are studied. Spatz can be used for a wide variety of applications from the medical to the materials sciences.



Neutron reflectometry

Neutron reflectometry provides information on the composition, thickness and interfacial roughness of thin films with the precision of a few atoms. These experiments may be carried out at air/solid, solid/solid and solid/liquid interfaces under a wide range of conditions.

What makes Spatz special?

Spatz is a neutron reflectometer capable of examining surfaces, thin films, buried interfaces, multi-layered structures and processes that occur at surfaces and interfaces. This can be done under a wide range of different environments. Spatz is also well set-up for studies of kinetic processes down the minute or less timescale. The large angular range of the detector means wide-angle diffraction on multi-layered systems is possible. Finally, Spatz also has a dedicated infra-red spectrometer for *in situ* ATR-FT-IR spectroscopy that can be conducted simultaneously with neutron reflectometry measurements.

Applications

Neutron reflectometry can provide valuable information in a wide variety of scientific and technological applications at surfaces and interfaces including:

- Surfactants, colloids and polymers
- Biological membranes
- Corrosion
- Lubricants
- Chemical and biological sensors
- Functionalised surfaces

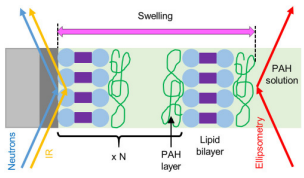
CASE STUDIES

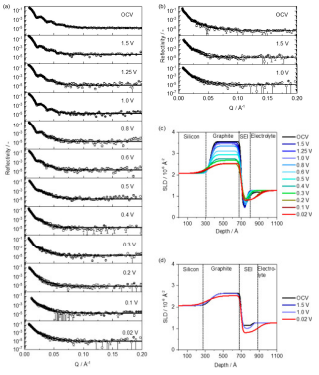
Case studies taken from when Spatz was the V18 BioRef Reflectometer at the Helmholtz Zentrum Berlin.

Modelling the lubrication of mammalian joints

This study was to understand the degradation of the lipid coating found in cartilage, a major cause of osteoarthritis in mammalian joints. Those with osteoarthritis have a reduced concentration of the molecule hyaluronic acid in the fluid that keeps joints lubricated. In this experiment a molecular level model of a joint was successfully made using a polyelectrolyte, PAH, to replicate the properties of hyaluronic acid. Neutron reflectometry was used to observe the swelling and de-swelling of the model joint as the concentration of PAH was changed. This work provided insights into how synthetic molecules could be used to treat osteoarthritis.

F. Schwörer et al., *Langmuir* 2018 **34** (4), 1287-1299





Building better lithium-ion batteries

The solid electrolyte interphase (SEI) is an important, but fragile, part of lithium-ion batteries. Due to the SEI being so fragile, it has to be studied in situ, making neutron reflectometry ideally suited to investigating the formation of this important component of lithium-ion batteries. A model anode of a lithium-ion battery was formed and the formation of the SEI was observed under different conditions. The results from the neutron reflectometry provided important information on how the SEI was formed and its chemical makeup.

M. Steinhauer et al., *ACS Applied Materials & Interfaces* 2017 **9** (41), 35794-35801

SPECIFICATIONS

Time-of-Flight instrument located on the cold-neutron guide CG2B. A flexible four chopper system defines the incident beam.

Wavelength range:
2 - 20 Å

Wavelength resolution:
1 - 11% (selected through the chopper configuration)

Q resolution:
1.5 – 17 % (combination of chopper and collimation settings)

Minimum Specular Reflectivity:
10^{-7}

Sample geometry:
Vertical

Off Specular Capability:
Yes

Q-range:
~0.006 – 2.0 $Å^{-1}$

Maximum flux at sample position:
10^8 n cm^2 s^{-1}

Detectors:
2D position sensitive ³He detector

Sample environments:
Solid-liquid cells
In situ Fourier Transform Infra-Red (FTIR) spectrometer
HPLC pump for solvent exchange
Water baths for temperature control

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