I22 Small Angle Scattering and Diffraction

Small angle scattering is a powerful tool for structural investigations of condensed matter. It can be applied to samples that are either difficult or impossible to crystallise, may be complex or composite systems or materials with large scale self-organisation. Due to the wide range of sample types, small angle scattering has been employed in a wide range of applications; from drug delivery systems and protein shape analysis through to catalysis, advanced materials development and engineering. The high intensity of the X-rays on I22 allows structural investigation of non crystalline materials under *in situ* conditions (for example fluid flow at high pressures and temperatures). I22 provides reliable access to millisecond and shorter time scales, essential to understanding kinetic processes such as early folding events in proteins or ordering and alignment in liquid crystalline materials. Information can be obtained on the shape and size of particles and macromolecules such as polymers and proteins which may not be possible using other techniques.

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**Beamline Specification**

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessible Length Scales [nm]</td>
<td>0.1 - 500</td>
</tr>
<tr>
<td>Energy Range [keV] / Wavelength [Å]</td>
<td>8 – 20 / 0.62 – 1.55</td>
</tr>
<tr>
<td>Beam Size at Sample [µm]</td>
<td>250 x 300 (H x V)</td>
</tr>
<tr>
<td>Sample Environments</td>
<td>Temperature range 90 K - 873 K</td>
</tr>
<tr>
<td></td>
<td>Pressure cell (up to 5 kbar)</td>
</tr>
<tr>
<td></td>
<td>Rheometer, stopped flow, DSC and HPLC</td>
</tr>
<tr>
<td></td>
<td>Sample changers for all sample types</td>
</tr>
<tr>
<td>Detectors</td>
<td>2D SAXS fast photon counting detector (RAPID)</td>
</tr>
<tr>
<td></td>
<td>2D SAXS high resolution detector (Pilatus 2M)</td>
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<tr>
<td></td>
<td>2D CCD detector (MarCCD)</td>
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<tr>
<td></td>
<td>1D WAXS fast gas microstrip detector (HOTWAXS)</td>
</tr>
<tr>
<td>Time resolved measurements</td>
<td>Sub ms timescales</td>
</tr>
</tbody>
</table>

For further information please contact the Diamond Industrial Liaison Office on

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Proteins & Biomaterials

- Determination of the size and shape of proteins in solution (can be used for proteins that do not crystallise);
- Studies of ligand binding;
- Investigation of phase behaviour of lipid and biomimetic systems under a wide variety of conditions;
- Biological fibres such as collagen structure in corneal tissue to understand eye disease.

Polymers

- Simultaneous structural and rheological studies of polymers under shear for using in food packaging;
- Block copolymer phase behaviour can be investigated with simultaneous DSC measurements;
- Self-assembled microstructures identified for drug delivery technologies, for example slow release (gel) or encapsulation (core shell particles).

Environmental

- Following corrosion processes including pit formation;
- Time resolved measurements of nanoparticle nucleation and growth;
- Structural investigations of ceramics, glasses and advanced materials.

Colloids & Surfactants

- Particle shape analysis and particle size distribution information can be obtained for colloidal suspensions;
- Complex liquid crystalline phases can be identified and used as templates for catalysts;
- Phase behaviour in self-assembled systems such as paints, cosmetics and detergents.

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