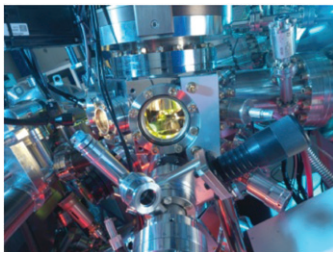
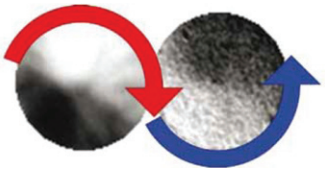
Technique Information

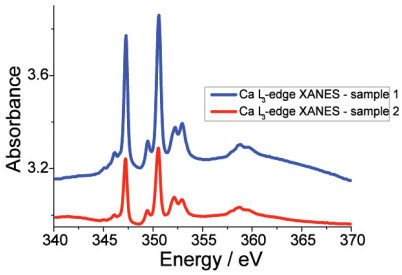
I06 - Soft X-rays for Materials

Understanding matter at the nanometre scale allows us to design materials and devices with finely tuned properties and behaviours with a huge range of applications. The Soft X-rays for Materials beamline exploits the brightest region in Diamond's spectrum, providing an intense, polarised beam which can be focused to a spot several microns in diameter, allowing the study of nanomagnetism and nanostructures. I06 produces soft energy X-rays with variable linear and circular polarisation for X-ray Absorption Spectroscopy (XAS) which allow the study of light elements such as carbon, oxygen, nitrogen and sulfur present in the specimen. Moreover, due to the soft energy range available at this beamline, detailed L-edge XANES studies of heavier elements are feasible. The beamline also has the capability to collect element specific data at high spatial resolution (~20 nm) by means of spectroscopies such as polarised XAS or X-ray photoemission spectroscopy (XPS).

X-ray photoemission electron microscopy (PEEM) measurements available on I06 provide information about the morphology, electronic properties and magnetic state of materials on nanometre length scales. Therefore, this technique can lead to better understanding of the performance of industrial materials, for example thin films, multilayers, clusters, giant magneto-resistive metals and metal-semiconductor spintronic materials.







Beamline Specification

Beamline I06	Branch line (XAS)	PEEM
Energy Range (eV)	106 – 1300 (circular dichroism) 80 – 2100 (linear dichroism)	
Typical sample volume [mm^3]	10 x 10 x 1	
Spot size [μm]	200 (H) x 20 (V)	10 (H) x 3 (V)
Resolving power ($\Delta E/E$)	10,000 @ 400 eV	
Resolution of PEEM		50 – 100 nm
Resolution with electron microscope		20 nm
Imaging spectral resolution		300 meV
Resolution of XPS	200 meV	
Temperature	Cryostat (5 – 273 K) Heating system (295 – 1273 K)	
Pressure	10^{-5} mbar	$<10^{-9}$ mbar
Sample requirement	By discussion	UHV compatible, conductive

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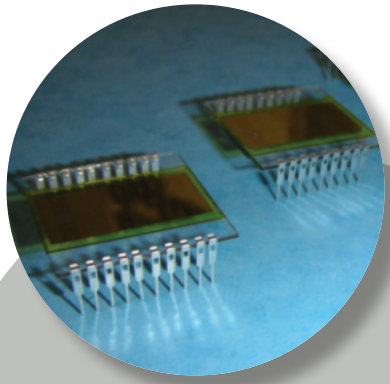
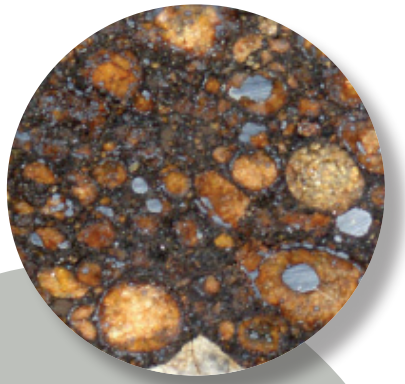
Applications

Industrial research at Diamond



Nanomaterials

• Probing the structure-function relationship of nanostructures applied as sensors, high density visual displays, memory storage devices under environmental control (e.g. temperature, magnetic field).



Materials

• Tracing light elements present in the sample such as C, N, O, S;

• Studying the elemental composition of materials contaminations;

• Probing an interactions of the materials with adsorbents or lubricants;

• Investigate the electronic properties and chemical species of impurities present in the sample.

Environmental

• Studies of the nature and distribution of light elements in soils, rocks and sediments;

• Monitoring the interaction of materials with the mineral surface;

• Studies of biofilms and their ability to modify surface chemical environments.

Nanocatalysts

• Probing the elemental composition of individual bimetallic/component clusters;

• Exploring segregation and the influence of the substrate on alloying behaviour and electronic structure;

• Studies of catalyst structure and their interactions with the chemical reagents under various environmental conditions e.g. three-way catalysts and fuel cells.

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