Bruker ASC is offering wide range of laboratory analytic techniques for spectral investigations using laboratory sources for extreme ultraviolet (XUV, EUV and soft X-ray) radiation in the spectral range from 2 nm to 50 nm (25 eV to 500 eV).

**Analytic Techniques**

We are offering different laboratory XUV analytic techniques, such as:

- Near Edge Absorption Fine Structure (NEXAFS)
- Grazing Incidence XUV Reflectometry (GIXUVR)
- Near Normal Incidence on multilayer
- Multi-Angle Spectroscopy
- XUV Scatterometry
- XUV Ellipsometry

**Potential Applications**

Our techniques can cover wide range of potential industrial and scientific applications, e.g.:

- semiconductor industry,
- organic technology,
- biological analysis,
- oil tribology and environmental studies.

**Benefits**

Our laboratory stand-alone solutions exhibit specific advantages:

- availability at your home lab
- compactness
- low measurement time (few seconds)
- in-line/ in-situ with production systems
The extreme ultraviolet is supplementing the accessible range of electromagnetic radiation. Depending on the use acronyms like "soft x-rays", XUV, EUV or VUV are used.

CONCEPTS

Polychromatic Approach

Our stand alone reflectometry and spectroscopy techniques are based on our proprietary polychromatic approach. In this approach the whole part of the spectrum emitted from the source falls onto the sample. The reflected light is spectrally dispersed and detected with a CCD detector. This concept, in particular, allows short measurement time (seconds or below) and fast data acquisition which is specially adapted to our plasma emitting thermal radiation sources.

Near Edge Analytics

Bruker ASC supplies stand-alone XUV-NEXAFS solutions in both monochromatic and our proprietary polychromatic illumination concept.

Near edge analytics like absorption spectroscopy as NEXAFS or XANES are well established for:

- chemical analysis of materials and compounds such as composition, bindings and chemical states
- investigation of electronic structure of matter, e.g. band structure, occupied and unoccupied valence states, core levels
- molecular orientation with respect to the substrate

Grazing Incidence Analytics

Bruker ASC provides XUV grazing incidence reflectometry (GIXUVR). GIXUVR is providing the reflectivity as a function of incident wavelength at a fixed grazing angle or vice versa. The technique is proven to be a surface sensitive technique to characterize thin films, surfaces and interfaces as well as structural properties. Thin film properties such as, chemical composition, layer thickness, roughness and density of a deposited layer can be determined indirectly from reflectivity curves.

XUV is of special interest for nanotechnology, because it has the highest radiation matter interaction cross sections and includes elemental specific absorption edges (K-, L- and M-shell) of nearly all elements.
PRODUCTS

Compact XUV Spectrophotometer (CXUVS)
The CXUVS is a stand-alone compact XUV spectrophotometer tool covering full range of analytic concepts, from grazing incidence reflectometry to near normal incidence reflectometry. It also covers transmission, fluorescence, spectral scatterometry and NEXAFS measurements.
CXUVS allows performing spectrally resolved, absolute characterization of optical elements like filters, windows, mirrors, coatings, absorbers, beam splitters etc.
The CXUVS uses our proprietary polychromatic spectrometry approach also applied in our high end EUV mask reflectometer.

High Throughput EUV Mask Blank Reflectometer (MBR)
Another prominent example of our stand alone reflectometry technique is EUV-mask blank reflectometer (MBR), which is a stand-alone tool specially designed for the investigation of EUV mask blanks. The tool allows for verifying the compliance with final specifications according to SEMI-standards and purchase specifications. High end specs as accuracies of better 2 pm in wavelengths, which corresponds to < 20 meV at 13.5 nm and 0.1 % in absolute reflectivity are achieved and set the landmark of XUV potential as does the mitigation of nano-contamination and the clean-room compatibility.

Tailored Solutions
With XUV stand-alone solutions, we expect to be able to transfer many experiments which are routinely being performed at beamlines to the individual laboratories. Our technology can be tailored to fulfill any specific solution as well as any generic ones. With our portfolio of components, experience and design concepts we usually start from the top-level specifications for combining the selected components like source, grating, sample handling, geometry and integration as to supply the most suitable and simultaneously most economic solution.

View into EUV-MBR, product of Bruker ASC, shows the EUV source and the sample chamber. Beam path is schematically demonstrated in red.

Some of the experimental results have been developed within research projects with collaborating partners:
Experience

Bruker ASC (formerly ACCEL) are well-known for the customer-specific design and supply of high-end solutions for synchrotron and beamline instrumentation. The range of successful deliveries starts from accelerators and accelerator components (e.g. superconducting Niobium resonators). Covering quadropole magnets and insertion devices, it also covers full beamlines or beamline components like monochromators, mirror and slit systems and the user-specific end-stations.

Within the end-stations Bruker ASC has accumulated know-how in nanometer resolving microscopes and different analytic techniques. As only one example, we have realized the end station “EUV-reflectometer” for PTB at BESSY in Berlin which is operating since 2002. Nearly all high-end measurements on optics for EUV-Lithography in Europe have been performed with this tool, which is able to measure all forms of EUV-samples with a diameter up to 500 mm in a vacuum of about $10^{-7}$ mbar.

XUV Sources

Laboratory XUV sources are the “workhorse” of the stand alone XUV techniques. Although the region of extreme ultraviolet has been a strong domain of synchrotron sources so far, the recent, scientific, technical and industrial progress in laboratory XUV light sources has opened up new possibilities for laboratory size tools, which may transfer most of the established techniques at beamlines.

Our sources include both discharge produced plasmas (DPP) and laser produced plasma (LPP). This is to cover the wide range of features required for different applications, like narrow- or broad-band emission, high flux, high brightness, spatial coherence, spectral ranges etc.

Mainly driven by the semiconductor industry’s demand for developing both scanner and metrology sources for the EUV-lithography, great progress has been made on these sources. The expertise at Bruker ASC on metrology sources has been strengthened by the integration of AIXUV in early 2010 and by its research partner Fraunhofer Institute for Laser Technology (FhG-ILT).

The availability of such sources opens up new opportunities for the development of future metrology tools.