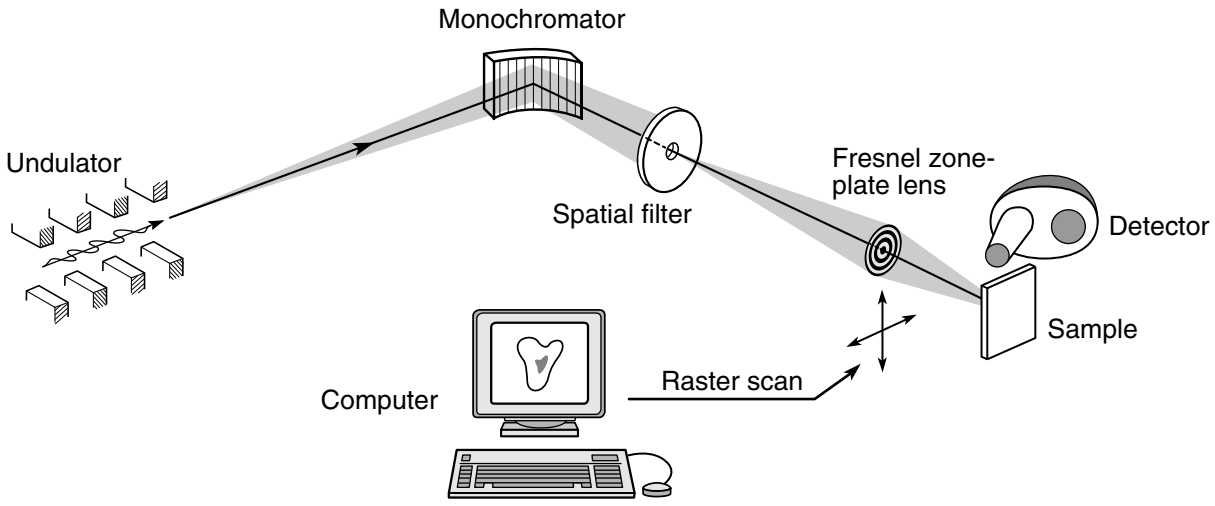
Scanning Photoemission Microscope (SPEM) • Beamline 7.0.1

Berkeley Lab • University of California

Endstation Specifications

Photon Energy Range (eV)	Photon Flux (photons/s/0.01%BW)	Spectral Resolution (E/ΔE)	Spatial Resolution (nm)	Samples	Availability
100 – 800 (at selected working energies)	**10^8 – 10^9** (typical focused flux)	**3000** (typical ΔE = 500 meV)	**150** (with XPS contrast)	**UHV-Compatible Solids** (up to 25-mm diameter)	**NOW**



Schematic layout of the SPEM endstation.

Beamline 7.0.1 serves several experimental stations collectively comprising "The Spectromicroscopy Facility." The scanning photoemission microscope (SPEM) on Beamline 7.0.1 performs both x-ray photoelectron spectroscopy (XPS) and near-edge x-ray absorption fine-structure spectroscopy (NEXAFS) of microscopic areas on sample surfaces and makes photoelectron images. Separate data sheets describe a scanning transmission x-ray microscope (STXM) and an UltraESCA station that shares beamtime with SPEM and STXM by means of deflection mirrors.

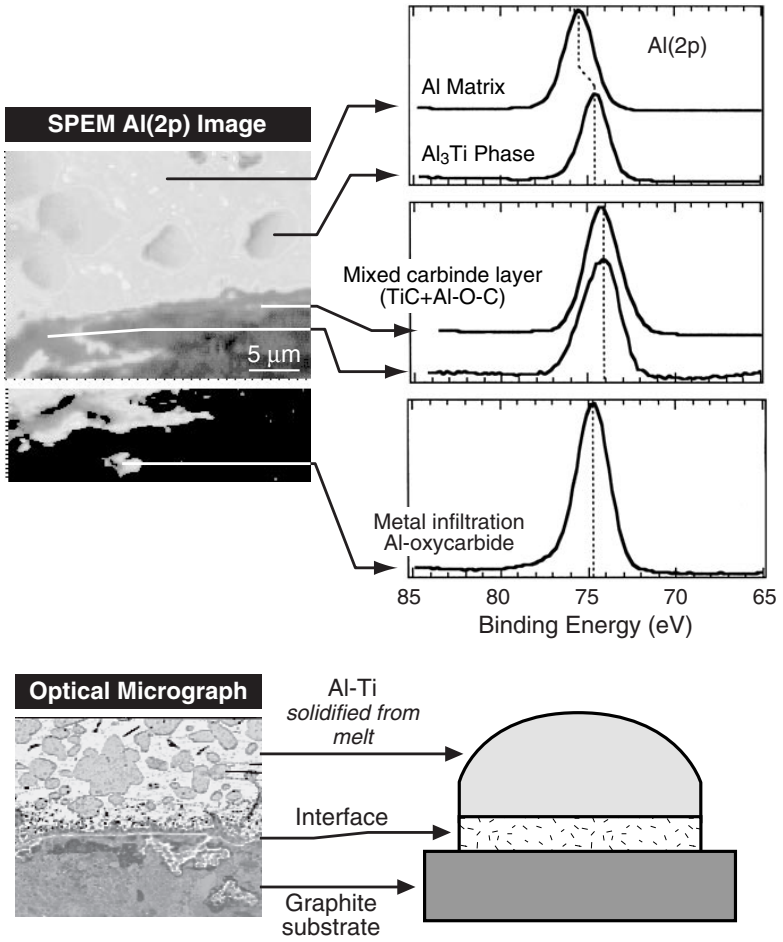
SPEM uses a Fresnel zone-plate lens to produce a demagnified image of the diffraction-limited undulator radiation filtered through a pinhole. Zone plates currently in use produce a spot size of 150 nm with a working distance between the order-sorting aperture and the sample of 0.8 mm. An x-y scanning stage moves the lens transversely through the x-ray illumination so that the focused spot is rastered across the sample surface. Regions of the sample up to 100 μm across can be imaged in this way.

The instrument operates over the photon energy range from 200 to 800 eV at selected values depending on the particular zone plates installed. Some variation of the photon energy (about 30%) around the selected value is possible for NEXAFS.

Owing to the wavelength dependence of the focal distance of the zone plate, the stage must also translate longitudinally for NEXAFS spectral scans. The SPEM station includes a hemispherical electron energy analyzer for XPS spectroscopy. Peaks in XPS spectra also provide contrast for XPS imaging and the signal for NEXAFS.

SPEM measurements are made in UHV. Sputtering and annealing capabilities are provided in a preparation chamber, with transfer into the SPEM chamber under a vacuum. An optical alignment telescope views fiducial marks on the sample surface for transverse positioning prior to scanning.

A typical scenario might consist of imaging the surface by scanning and counting specific photoelectron peaks, followed by a detailed spectroscopic examination of the most important features. ■



SPEM images and Al 2p XPS spectra *from a metallurgical study of Al/Ti melt interactions with solid graphite. Early results provide quantitative chemical shifts and stoichiometry of alloy precipitates and carbide formation at the interface. Data courtesy of S. Seal, T. Warwick (ALS), N. Sobczak (Foundry Research Institute, Poland), A. Garcia, H. Ade (N.C. State University), J. Denlinger (U. Michigan-Ann Arbor), B. Tonner (U. Wisconsin-Milwaukee).*

This endstation is available to independent investigators by submitting a proposal.

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