ELECTRON SPECTRO MICROSCOPY (ESM)

BROOKHAVEN NATIONAL LABORATORY

NATIONAL SYNCHROTRON LIGHT SOURCE II

SCIENTIFIC SCOPE

The Electron Spectro Microscopy (ESM) beamline at sector 21-ID provides a wide photon energy range (15 – 1500 eV), high resolving power (10^4-10^5), micro-focused beam to perform high-quality photemission experiments. The beamline serves, one at a time, two complementary photoemission microscopes: a high energy-resolution ARPES instrument working in scanning mode (1 μm lateral resolution) and a full-field AC-LEEM/XPEEM instrument (<10 nm lateral resolution; run in partnership with BNL-CFN). The combination of the two microspectroscopies allows to probe the properties of materials with unprecedented levels of sophistication and precision.

BEAMLINE CHARACTERISTICS

TECHNIQUES:

- High-resolution valence band μ-ARPES
- Spin-Polarized ARPES (double mini-Mott detector)
- Core level Spectroscopies (XAS, XPS, XMCD)
- Aberration Corrected LEEM.
- Aberration Corrected XPEEM

BEAMLINE DETAILS:

- Two in-line ID: QP-EPU105 & EPU57
- VLS-grating PGM:
  Plane mirror: directly H_2O-cooled M2
  gratings: 300, 600, 800, 1200 l/mm
  <1 meV from 15 to 100 eV
  ~ 60 meV at 1000 eV
- ARPES branch: KB refocusing optics
- PEEM branch: Ellipsoidal optics

ENDSTATION DETAILS:

- ARPES branch:
  - T: 30 to 2000 K
  - LEED/sputtering/e-beam evap.
- XPEEM branch:
  - T: 150 to 2000 K
  - LEED/sputtering/e-beam evap.

ESM at NSLS-II:

- High-resolution mappings of the electronic structure of complex material.
- Spectro-microscopy analysis: 1 micron scanning ARPES; < 10 nm full-field XPEEM.
- Core level spectroscopies allow for analytic quantitative composition analysis and for element specific signals.
- Atomic structure and topographic maps of surfaces.
- In-situ probing of solids-gas reactions.

ESM: Bridging Length-Scales

PEEM/LEEM (~10nm)	μ-ARPES (μm)	ARPES (0.3 mm)

Overview

PORT: 21-ID

SOURCE: QP-EPU105 & EPU57, in-line

ENERGY RANGE: 15 – 1500 eV

ENERGY RESOLUTION: $\Delta E/E = 10^{-4}$ -10^{-5}

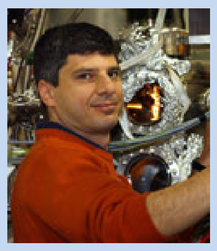
SPATIAL RESOLUTION: 1 μm (ARPES), 10 nm (XPEEM)

BEAMLINE STATUS: Commissioning

BEAMLINE PHONE: 631.344.1621

BEAMLINE WEBSITE: www.bnl.gov/nsls2/beamline/21-ID

Beamline Staff



Elio Vescovo
Lead Beamline Scientist

Andrew Walter
Beamline Scientist

Jurek Sadowski
CFN Scientist

Apply for Beam Time

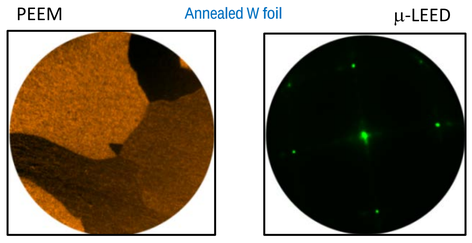
Beamlines at NSLS-II are available to all scientific researchers through a peer-review proposal process. For more information, see the NSLS-II Users' Guide at:

www.bnl.gov/ps/userguide/

SCIENTIFIC APPLICATIONS

Small Samples & Poly Crystals

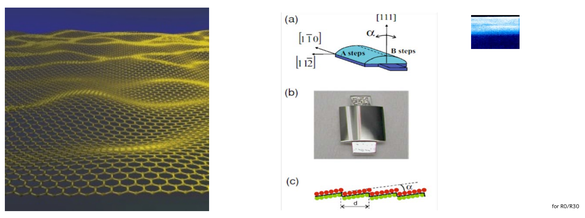
PEEM — Annealed W foil — μ-LEED



Extremely small samples (micron size) will become measurable with the intense and micron-focused beam produced at ESM. Additionally sample inhomogeneities will also be studied. These could be artificially engineered as in micro-devices or naturally occurring as in the crystalline grains of a the tungsten foil shown in the picture above.

2D Materials, Surfaces & Interfaces

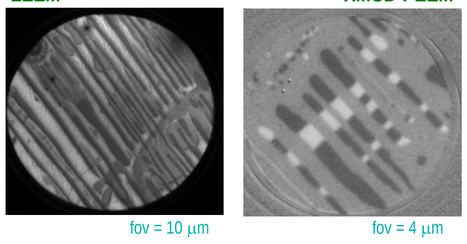
Graphene & Curved Surfaces



The use of micro-structured substrates for crystal growth allows for the systematic investigation of substrate-thin film interactions. In a "curved crystal" the size of the terraces decreases towards the edge due to the curvature. In such crystals we see variations on the micron scale. The right figure shows ARPES images from two rotational domains of Graphene on a curved Pt crystal.

Magnetic Materials

LEEM — Fe – nanowires on W(110) — XMCD-PEEM



XPEEM XMCD image of Fe(110) nano-wires deposited on W(110). The size of the magnetic domains (black and white: oppositely magnetized regions) is within a field of view of 10 microns. These wires cannot be remanently magnetized. The spin-polarized electronic structure of these wires will be measurable at the ESM μ-SP-ARPES end-station.