Specifications

ARPES

Modes of operation

- Angle-resolved/integral PES (SCIENTA R4000)
  - 0.1 - 4.0 mm lens slits
  - 1 - 10 & 20 - 200 pass energy ranges
  - 1.8 meV FWHM at pass 2 & Ek 20 eV
  - Acc. angles +/-19 (transmission mode)
- Low-energy electron diffraction (LEED)
- Molecular beam epitaxy (MBE) - e-beam/effusion cells
- in-situ surface treatment
  - Ar ion sputtering (< 3 keV)
  - LHe cryostat (< 20K)
  - UHP gas exposure (Ar, He, O_2, N_2)

Photon Sources

Synchrotron from the undulator U60 (VLSPGM)

- Photon energy: 40 - 160, 220 - 1040 eV
- Resolving power: 10,000 @ flux 1×10^{10} phs.
- Beam size: 0.3 mm (H) x 0.1 mm(V)

XPS: Soft x-ray PES

Angle-intergral PES (CLAM2)

- 1 - 200 pass energies

Electron flooding filaments (no current feed-back or position/focus control)

in-situ surface treatment: Ar ion sputtering (< 3keV)

Beam size: 0.2 mm (H) x 0.2 mm(V)

Sample size: > 5 mm x 5 mm

XAS: Soft x-ray absorption

TEY (drain current) & TFY (MCP) modes

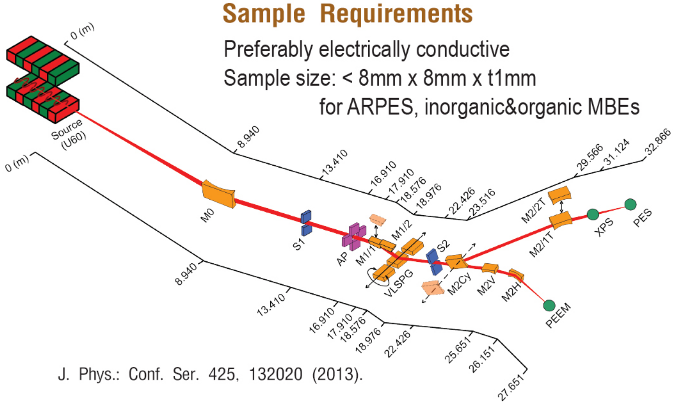
Sample size: > 5 mm x 5 mm

Sample Requirements

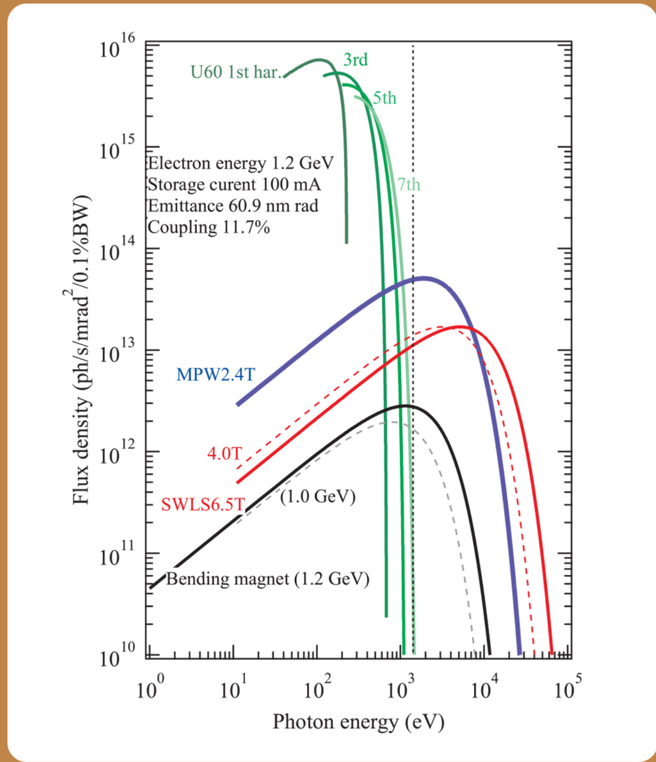
Preferably electrically conductive

Sample size: < 8mm x 8mm x t1mm

for ARPES, inorganic&organic MBEs



J. Phys.: Conf. Ser. 425, 132020 (2013).



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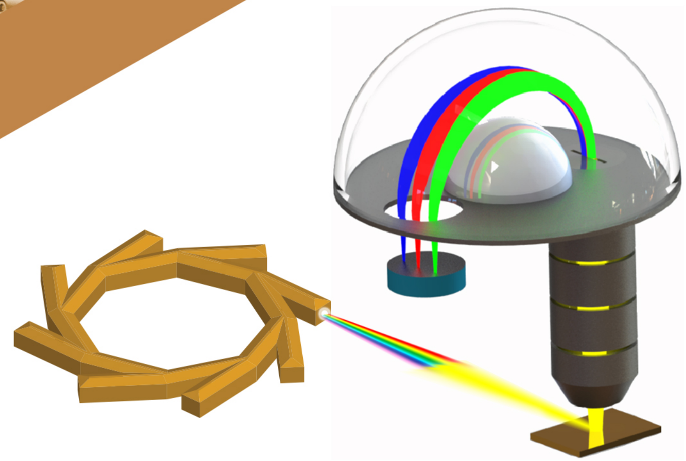


BL3.2Ua:

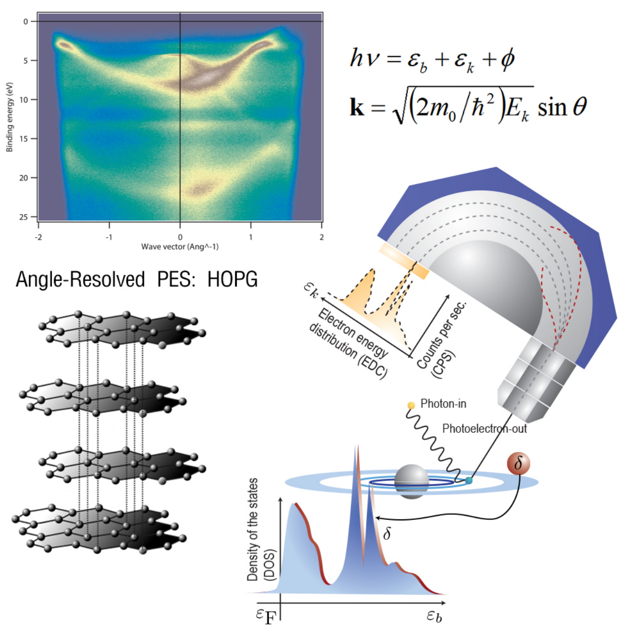
Soft x-ray AR-PES & XAS beamline

Synchrotron Light Research Institute (Public Organization)

www.slri.or.th

What is photoemission?

The photoemission spectroscopy (PES) analyzes the energy of electrons excited from the samples to study the electronic structure of materials. The electrons are mostly excited from the sample surface into vacuum by soft x-ray, so PES is a surface sensitive technique. The energy of electron excited depends on the energy of electrons in the ground state in the materials, so PES lets us know what atomic elements in sample surface. The energy of electrons excited in the composite is shifted by elements around it, so PES gives us information on the chemical state of composites. Angular distribution of excited electrons from thin film enables us to analyze the depth profile of elements from surface down to the interface of film on substrate. Large energy and momentum dispersions can be observed in the excited electrons by the vacuum-ultraviolet light (VUV), and their relations play an important role in the analysis of fundamental theory of exotic materials. The relationship between the lowest energy level (work function) and highest occupied molecular orbit (HOMO) level probed by PES directly maps the interface energy level alignment of semiconductor devices.



$$h\nu = \varepsilon_b + \varepsilon_k + \phi$$

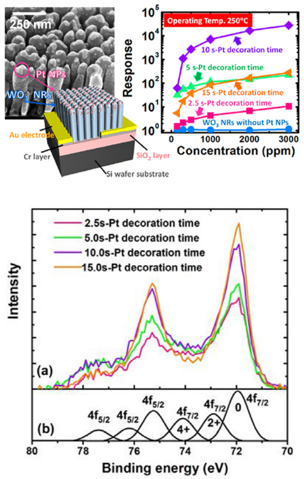
$$\mathbf{k} = \sqrt{\left(2m_0/\hbar^2\right)E_k}\,\sin\theta$$

Angle-Resolved PES: HOPG

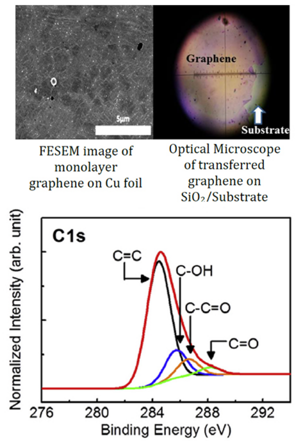
What can photoemission beamline provide?

The PES beamline (BL3.2Ua) provides an unique opportunity to study the electronic structure of materials by photoemission based on the synchrotron radiation facility (SLRI) in Thailand. The synchrotron radiation can deliver the lights for materials research with various advantages such as a wide spectrum (IR to hard x-ray), high flux, controllable polarization and excellent cleanliness. These characteristics play a crucial role in the high resolution analysis of electron excited in the energy and momentum space. The photon energy range in the PES beamline covers from 40 to 1000 eV with linear polarization under the ultra-high vacuum environment. In particular, the high-resolution PES is available in the photon energy range between 40 and 160 eV covering the rare-earth metal 4f peaks as well as valence band analysis. Photo-ionization spectroscopy (XAS) is useful from 220 to 520 eV covering C, N, O K edges or from 440 to 1000 eV covering Fe, Co, Ni L edges. XAS in total electron and fluorescence yield modes enables us to probe the surface and bulk sensitive electronic structures. Fluorescence yield mode can be measured even in the insulated samples.

NECTEC Dr. Mati et al., ACS Appl. Mater. Interfaces 6, 22051 (2014).

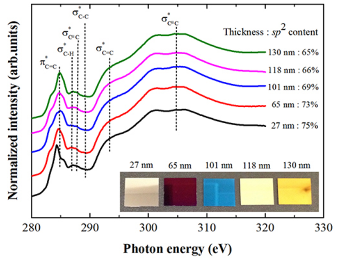


UM Mr. Syed et al., Carbon 86, 1 (2015). HFTCVD high-quality graphene



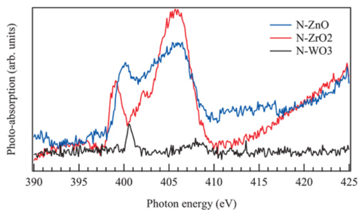
Research highlights

- Energy-band alignment analysis on thin-film organic/polymer semiconductor devices
- Characterization of high quality graphene/graphene oxides/diamond-like carbon (DLC) films
- X-ray/ion-beam exposure effects on TM oxides/polymer films/multilayer mirrors
- Investigation of damaged interior walls/hot-role steel surface in factory production
- Chemical analysis on Pt-decorated WO_3 nanorods for ultra sensitive hydrogen sensor
- Role of chlorophyll in Spirulina on photocatalytic activity of CO_2 reduction photocatalysts
- Improvement of thermal stability and reduction of $LiBH_4$ for reversible hydrogen storage
- Performance of nanocrystalline TiO_2-based dye-sensitized solar cells
- Oxidation of Zn in UHV environment at low temperature



NUT Mr. Sarayut et al.,
XAS C K edges on DLC films
Thickness dependent sp2/sp3 ratio

$$\frac{[sp^3]}{[sp^2+sp^3]} = 1 - \frac{I_{\pi,\,\mathrm{DLC}}/I_{\mathrm{all,\,DLC}}}{I_{\pi,\,\mathrm{graphite}}/I_{\mathrm{all,\,graphite}}}$$



TU Dr. Hanggara et al.,
Environ. Sci. Pollut. Res. 23, 10177 (2016).
XAS TFY N K edges in metal oxides