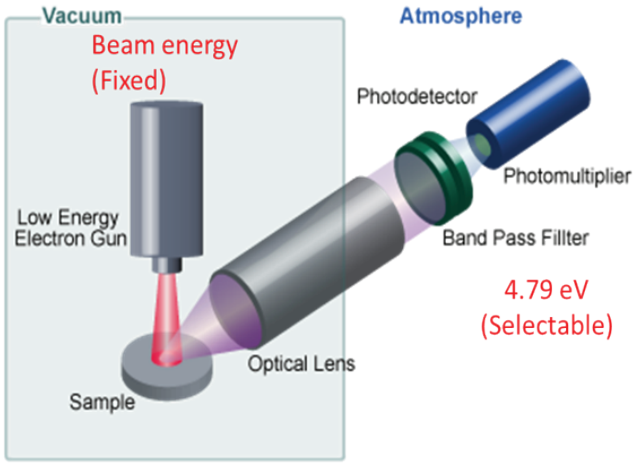
Low Energy Inverse Photoemission Spectroscopy (LEIPS) UPGRADE

Inverse Photoemission is the gold standard technique for measuring the unoccupied electronic states of surfaces including the Conduction Band Minimum (CBM) and Electron Affinity (EA). The energy of these excited states are critical parameters for improving performance in batteries, photovoltaics, and optoelectronic materials. LEIPS innovates on this established technique by using lower energy electrons and lower energy UV photons. These changes make LEIPS easier to use and improves energy resolution over traditional IPES, while also avoiding damaging sensitive samples including organic molecules, polymers, perovskites and more. When combined with our He^+ lamp for UPS, LEIPS enables a full energy diagram for conductive and semiconductive samples.

Key Features of LEIPS

- Measures the energy of unoccupied electronic states
- Measure band gap of semiconductors
- Can measure low band gap materials and metals
- Avoids damaging sensitive samples

LEIPS Experimental Concept and Advantages

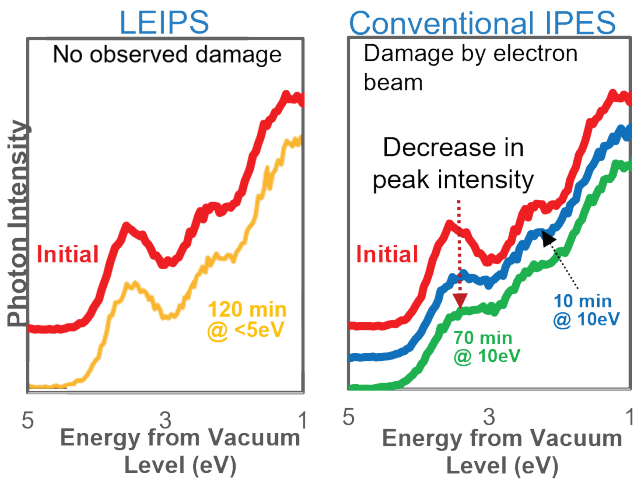


Sample bias (Scanned)→Incident electron energy (0 ~ 5 eV)

	LEIPS	Conventional IPES
Analysis Positions	Same position as XPS, UPS, Ar/C_{60}/GCIB ion guns, and AES/REELS	For dedicated IPES tool, sample transport required for XPS analysis
Incident Electron Energy	< 5 eV Near UV Low sample damage	~10 eV Vacuum UV Heavy sample damage
Selection of Photon Energy	Band pass filter easily changed outside vacuum in minutes	Band pass filter is UHV chamber, difficult to replace
Energy resolution	< 0.45 eV	~0.6 eV

Reduced Sample Damage:

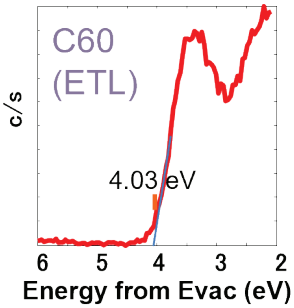
LEIPS spectra over time compared with conventional inverse photoemission (IPES). Organic molecules and other delicate materials are often damaged by the incoming electron beam and high energy photons. With LEIPS, the lower energy experiment preserves sample identity and enables confidence that the observed spectra come from the intended pristine material.

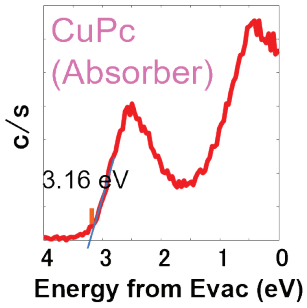


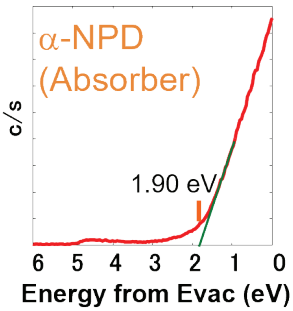
Experimental Analysis

Organic Solar Cells & OLEDs

In organic solar cells (and their reverse counterparts, OLEDs), the current and efficiency are controlled by the migration of electrons and holes, which in turn depends on the energetic alignment of the molecules in each component. LEIPS is uniquely suited to measure the energies of each component of the electron transport chain without damaging sensitive organic materials. Combining LEIPS with the UPS option enables characterization of the hole transport branch for a full complete picture of energy levels in these materials.

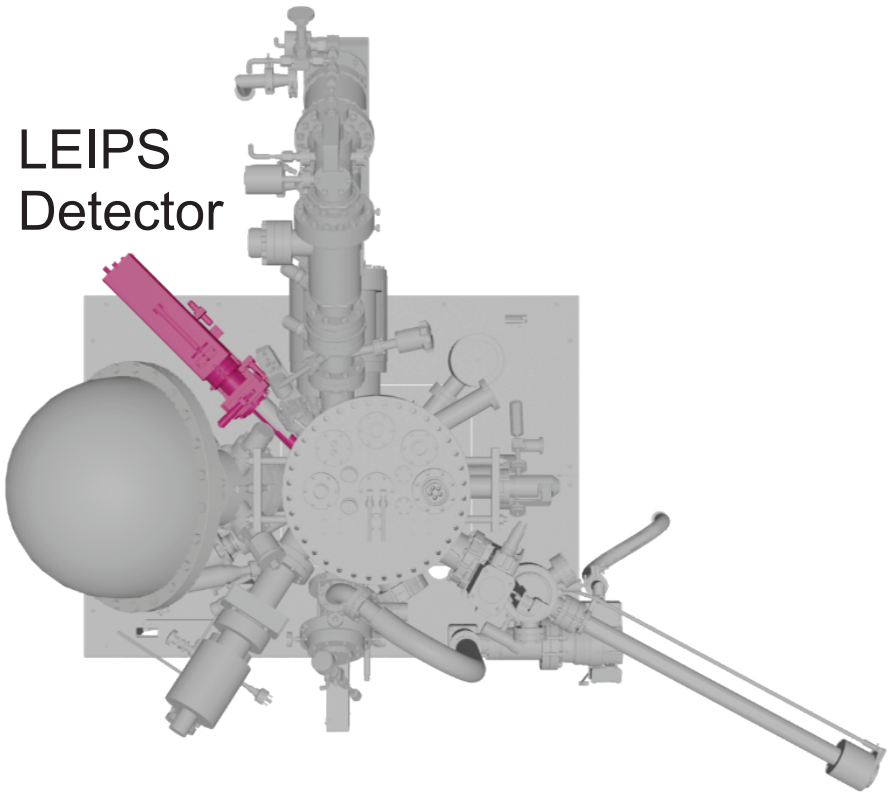






LEIPS Hardware

LEIPS measurements can be performed by ordering the LEIPS upgrade package. This includes the LEIPS detector, a dedicated LEIPS sample holder, a package of 4 wavelength selective optical filters, a new electron neutralizer designed specifically for high resolution LEIPS, control electronics, and vacuum adjustments to minimize stray light, and upgraded software which requires Windows 10. Please note: LEIPS is incompatible with the Dual Anode option.



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