



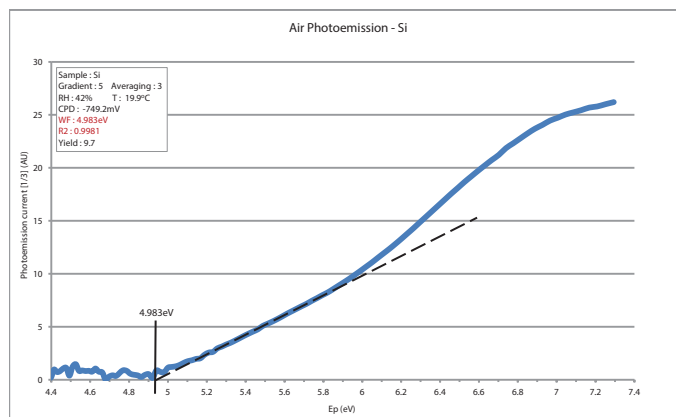
Ambient Pressure Photoemission Spectroscopy Systems

APS01, APS02, APS03, APS04

System Description

The Ambient Pressure Photoemission Spectroscopy (APS) systems are KP Technology Ltd's newest addition to our large surface analysis range and international patents are held for these instruments. The APS systems measure the absolute work function (Φ) or Volta potential ($\Delta\psi$) of a material by photoemission in air, no vacuum is required. With an excitation range of 3.4 eV to over 7.0 eV, the APS systems are capable of measuring the absolute work function of metals and the ionisation potential of semiconductors alongside measurement of the surface Fermi level with the Kelvin probe.

With the addition of an SPV and SPS source, the full bands of semiconductors can be measured in one system; no other product can do this.



Photoemission in air measurement of a silicon sample



Ambient Pressure Photoemission Spectroscopy APS04 system - scanning Kelvin probe with ambient pressure photoemission spectrometry and surface photovoltage spectrometry

Features

- Work function by photoemission in air
- Density of states measurements
- 3.4 eV to 7.0 eV energy range
- Measurement of all semiconductor bands
- Contact potential difference by Kelvin probe

Applications

- Organic and non-organic semiconductors
- Metals and metal alloys
- Thin films and surface oxides
- Solar cells and organic photovoltaics
- Corrosion and nanotechnology



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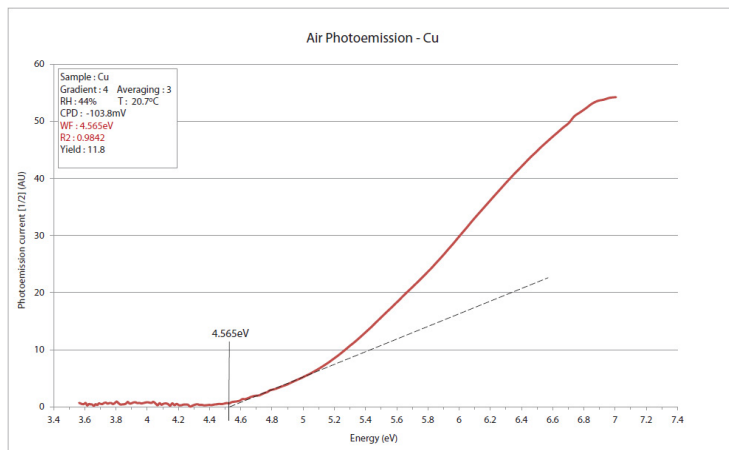
APS01, APS02, APS03, APS04

Measurement Principle

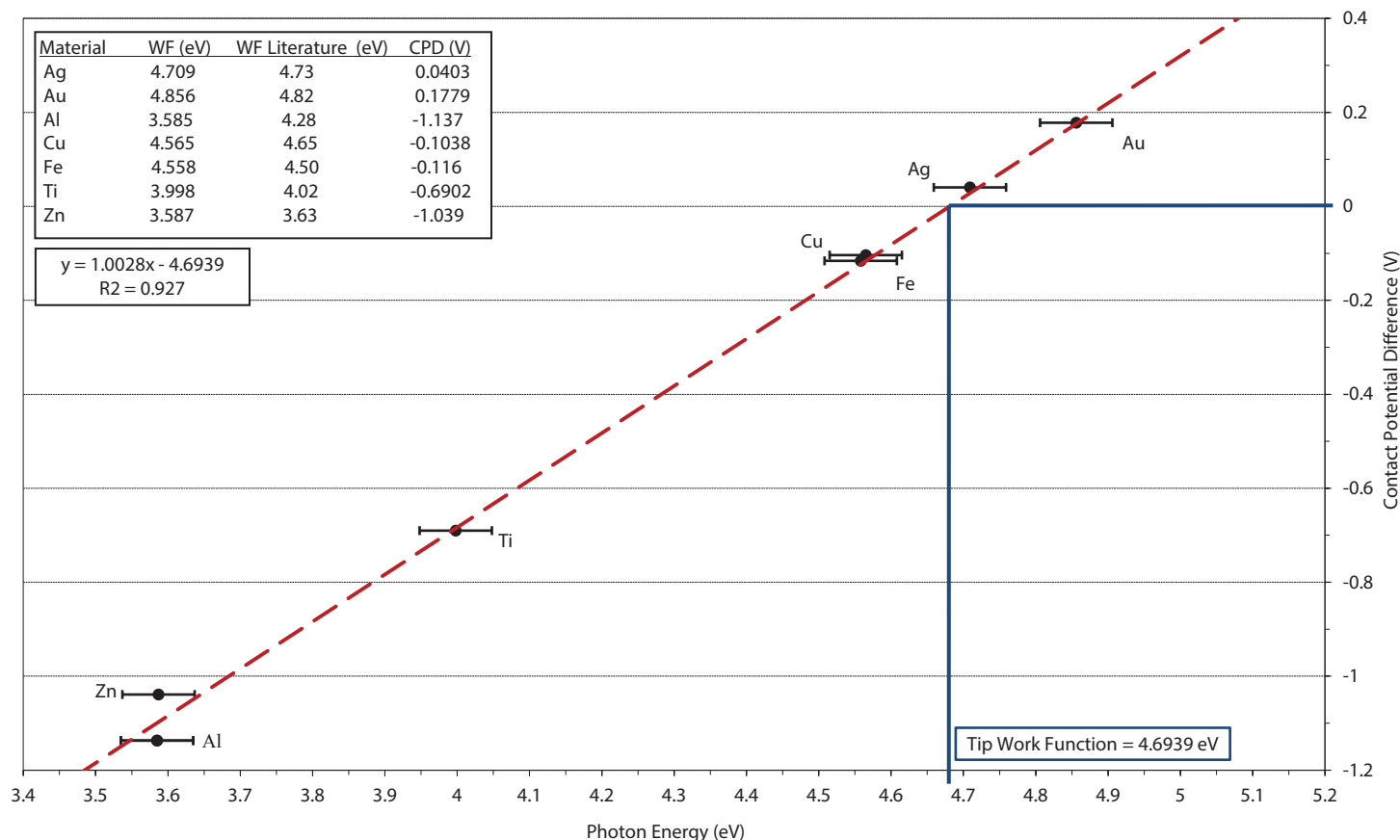
When light is incident on a material such as a metal or a semiconductor, the photons may have enough energy to liberate electrons from the surface, a process known as the Photoelectric Effect.

The energy required for electrons to escape the material is termed the work function or volta potential. By varying the energy of the incoming light, the absolute work function can be established.

Based on Fowler's analysis of photoemission, the square root (cube root for semiconductors) of the photoelectron yield is plotted on a graph versus the incident photon energy (image right). The work function of the material under analysis is where this straight line extrapolates to zero.



Air photoemission curve of copper sample



Ambient pressure photoemission measurements of a selection of metals.

Each metal was measured with the photoemission mode and Kelvin probe mode of an APS02 system. The contact potential difference (CPD) was measured with the Kelvin probe and the work function was measured by the ambient pressure photoemission mode. When work function is plotted against CPD, a straight line is formed. A line is drawn at 0 V CPD to the line and when traced down reveals the absolute work function of the tip.

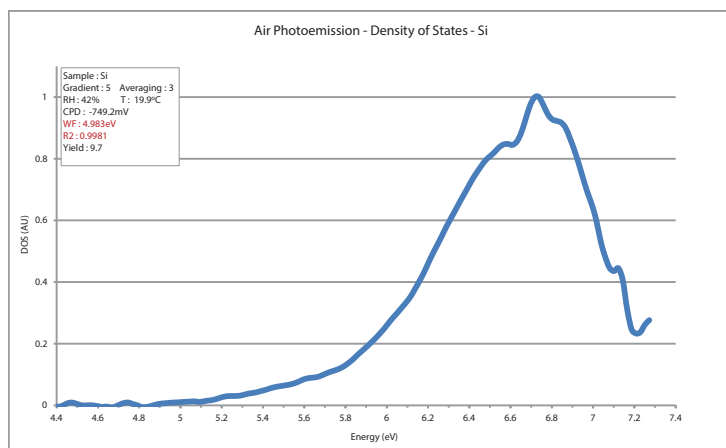


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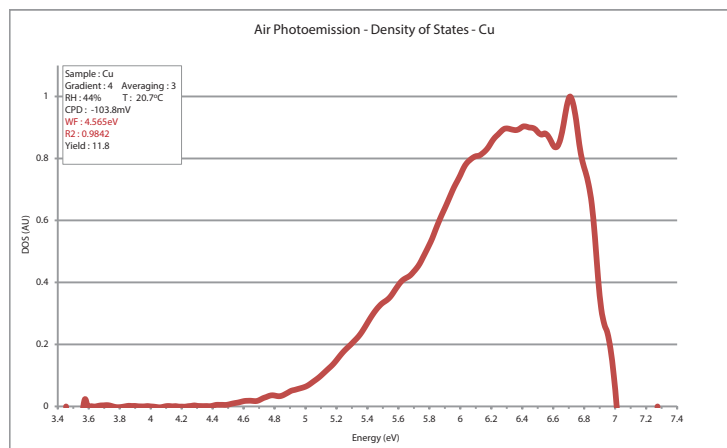
APS01, APS02, APS03, APS04

Density of States

The properties of many materials are governed by the Density of States (DOS) near the Fermi level. The Ambient Pressure Photoemission system is capable of probing the DOS by differentiating the detected photoelectron yield with respect to the incident photon energy. The DOS measurement can thus be compared to molecular orbital calculations for the material under investigation. DOS data collected with the APS in air is shown to the right for copper. The data for all measured samples is consistent with literature.

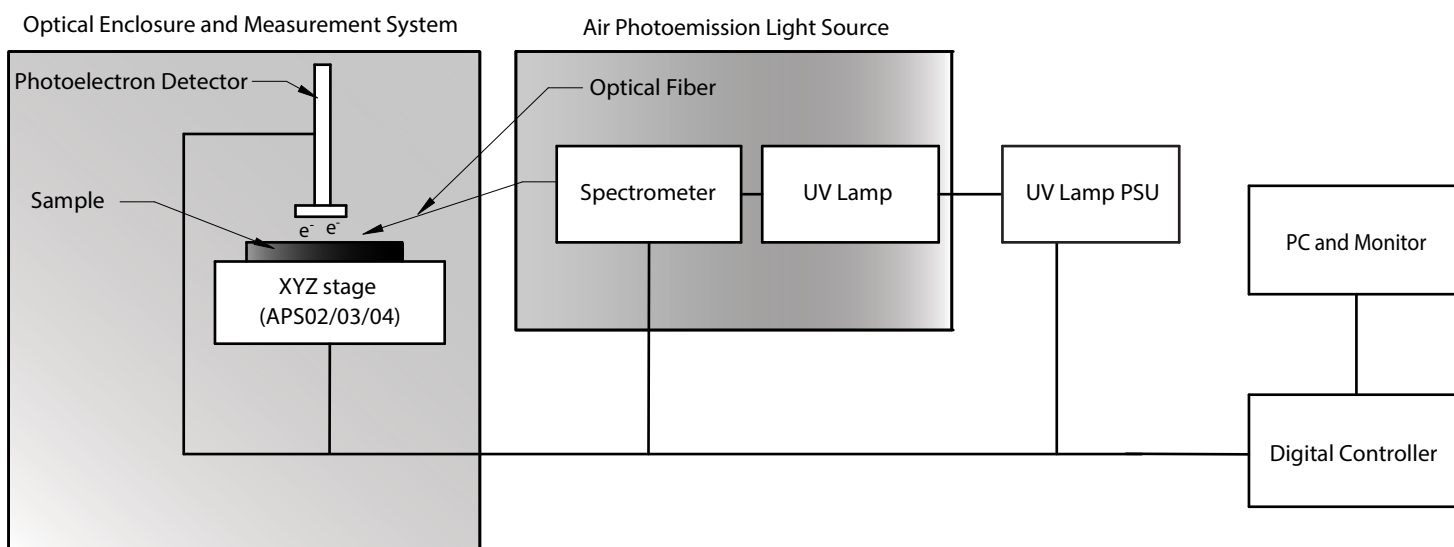


Silicon sample density of states



Copper sample density of states

System Overview



The optical enclosure houses the sample in complete darkness prior to measurement. The photoelectron detector measures the liberated electrons driven off by the UV light emitted by the spectrometer.

The UV bulb is powered by an external PSU and is controlled by software. The UV light is injected into the spectrometer and a variable wavelength of light is produced. The energy range of this light is 3.4 eV to 7.0 eV.

The digital controller controls every aspect of the system and is controlled by the dedicated software GUI. The measurement from the photoelectron detector is passed to the digital controller, to the PC and plotted in software, producing the PE curve.

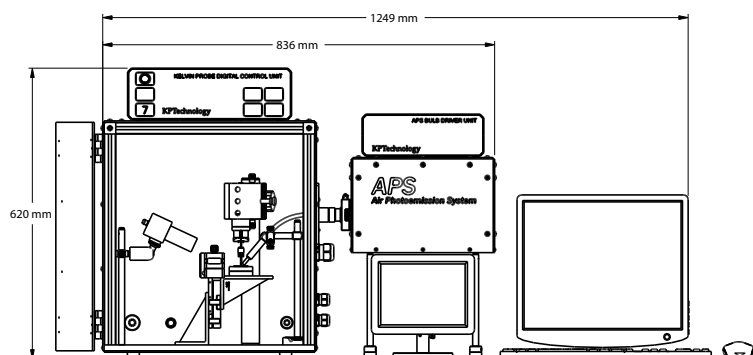


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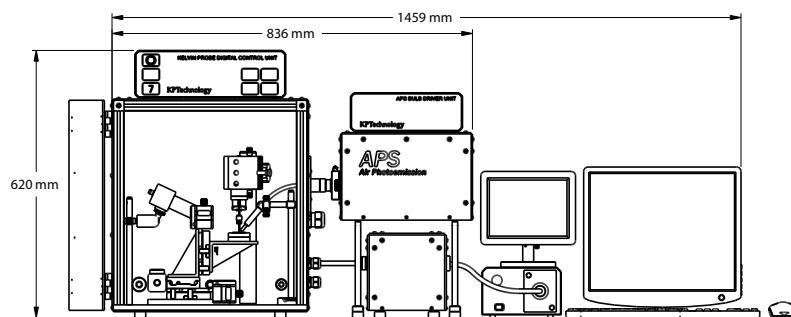
APS01, APS02, APS03, APS04

System Specifications

	APS01	APS02	APS03	APS04
Kelvin probe 3-axis scanning		✓	✓	✓
Surface Photovoltage			✓	✓
Surface Photovoltage Spectroscopy				✓
Tip material / diameter	2 mm gold tip			
CPD resolution	1-3 meV			
Height control (auto)	25 mm automatic			
Kelvin probe mode and PE mode	CPD and photoemission measurements			
CPD measurement time	CPD measurements in <1 min			
PE resolution	Full photoemission measurement			
WF measurement time	PE measurement in <5 mins			
DOS measurements	Full access to DOS information			
Optical system	Colour camera with zoom lens and monitor for positioning			
Oscilloscope	Digital TFT oscilloscope for real time signal			
Test sample	Gold, aluminium and silver test samples			
Faraday enclosure base	450 x 450 mm			
Control supplied	PC control with dedicated software			
Patented technology	US: 8866505, GB: 2439439, GB: 2495998, EU: 2783205, JP: 6018645			



APS02 system with scanning capability



APS04 system with Surface Photovoltage Spectroscopy

The Company

KP Technology Ltd was founded with the aim of bringing to the market new surface research tools. These tools have featured in over 250 peer-reviewed client publications in the last 3 years. KP Technology Ltd also performs a significant amount of material research and training consultancy, mostly based upon the work function (Φ) or surface potential evaluation of client samples. KP Technology Ltd holds international patents on their Ambient Pressure Photoemission Spectroscopy (APS) system for measuring absolute workfunction. Along with a strong research and development division and over 500 systems shipped worldwide, this has placed KP Technology Ltd as the leading supplier of Kelvin probes in the world.

Contact

For quotation requests, further information or to discuss any research or particular measurements, please feel free to contact us:

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KP Technology Ltd is the proud winner of the
Queens Award for Enterprise:
International Trade 2013

