DA30-L
Angle Resolved Electron Spectrometer

Since the launch in 2013, the DA30 (fig. 1) family of analyzers have revolutionized the field of ARPES (angle resolved photoemission spectroscopy). Using a deflector concept, this well proven analyser can measure electrons in a full cone of 30 degrees opening angle. This opens up for band mapping of the full surface Brillouin zone without the need to rotate the sample.

In the mid 1990's Scienta Omicron revolutionized ARPES with the introduction of parallel angle-resolving analysers, thereby allowing for simultaneous measurements of electrons with different emission angles without having to tilt the sample utilizing a 2D detector. The DA30 deflector principle is described in figure 2. This analyser concept represents the next breakthrough in ARPES instrumentation comparable to the development of parallel angle-resolved spectroscopy, since it enables full band structure measurements (in E, kx and ky) without sample rotation.

The deflection feature is a big advantage, since it ensures that the exact same position of the sample is probed during the whole measurement. When measurements are performed without sample rotation an additional advantages is that matrix element effects, caused by variations in ionization cross section for different photon to sample angles, are avoided. This possibility also improves both

spectral quality and measurement efficiency, since deflection is more accurate and faster than sample rotation. Another advantage, for some samples, is that when rotation requirements are decreased, it is possible to use sample manipulators with fewer degrees of freedom. This in turn not only simplifies the experimental setup, but also allows for lower sample temperatures.

ARPES Scan

Another important feature of the new analyser design is that the measurement range of the MCP/CCD detector (indicated in green in figure 1B) may be deflected not only in θ_x, but also in θ_y. In this way, a full cone of 0<θ<15 degrees may be probed without tilting the sample. This is outlined in figure 2. Experimental results are shown in figure 3.

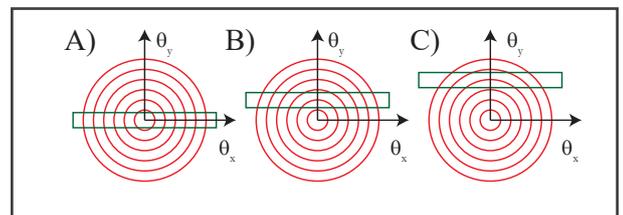Fig. 1: From the Electron Spectrometer pioneers: the DA30-L angle resolved electron spectrometer

Figure 2: Sequential deflection along θy enables measurements of the whole acceptance cone of the analyser without tilting the sample.
A: Deflectors off. B and C: Increasing deflection along θy.
For a description of the figure, see figure 1.

DA30-L at a glance:

- Improved ky accuracy (resolution better than 0.1°)
- Time saving (electronic deflection is faster than rotation)
- Matrix element effects are avoided by keeping sample fixed
- Manipulator requirements are reduced
- Ensures same spot for all k//
- A revolution in angle-resolved and spin-resolved spectroscopy
- Patented deflector concept
- Sequential full cone detection

Spin Scan

A major advantage of the Scienta Omicron MCP/CCD and Spin detection combination is that the parallel angular detection can be used to ensure that the spin-resolved measurement is performed at the desired point in k-space.

The Au(111) data seen in Figure 4 was recorded by using the ARPES mapping and Spin mapping modes of a DA30-L equipped with a 2D Ferrum VLEED detector. The complete data set was therefore acquired with fixed manipulator/sample position. The data clearly shows the separation of the spin bands and to the far right high resolution spin resolved data is presented. The red and blue colors denote the two spin directions and reviels the excellent resolution and statistics of the measurement.
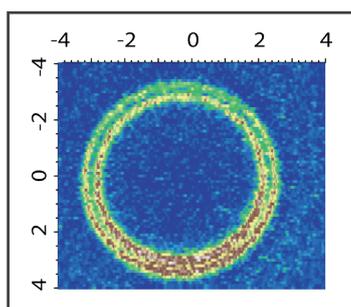

Figure 3: Fermi surface map of Au(111). Scan mode using angular mode 30.
Sample was not moved and spectrum was recorded at 77 K. Measuring time: less than 1 min.
Data courtesy: Dr. Ivana Vobornik, CNR-IOM, TASC Laboratory, AREA Science Park, Trieste, Italy.
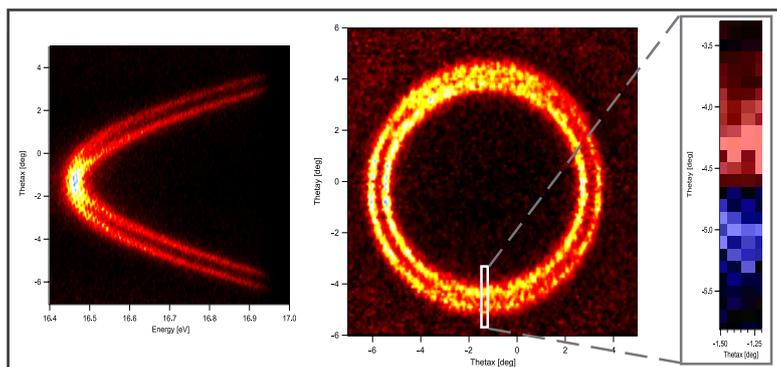

Figure 4: Spin-ARPES measurement of LHe cooled Au(111) recorded with a VUV5k source. The complete ARPES data was recorded in 10 min and the high resolution spin data in 2 h.
Data courtesy: Prof. Dengsung Lin, Dept. of Physics, NTHU, Taiwan

Technical Data

Property	Specification
Lens acceptance angle	38° full cone
Angular resolved range	± 15° full cone
Angular resolution	0.1° for 0.1 mm emission spot
	0.4° for 1 mm emission spot
Working distance	34 mm
Pressure	< 2×10⁻¹⁰ mbar
Baking temperature	150 °C
Analyzer radius	>180 mm
Mounting flange	NW 200 CF, rotatable
Slits	9
Detector type	MCP/CCD camera
Energy channels	>1000 simultaneous
Angular channels	> 750 simultaneous
Acquisition modes	Swept, Fixed
Detector modes	Pulsed, ADC
Detector interface	Ø 40 mm MCP or Ø 40 mm MCP VLEED spin solution

Models	DA30-L	DA30-L-EXT	DA30-L-8000
Resolving power	1750 (4000 theor)	1750 (4000 theor)	8000 theoretical
Energy resolution	1.8 meV	1.8 meV	1.0 meV
Pass Energy	2- 200 eV	2- 200 eV	1- 10 eV
Kinetic energy range			
Transmission mode	0.5- 1500 eV	0.5- 1500 eV	0.5- 12 eV*
Angular mode	3- 1500 eV	0.5- 1500 eV	0.5- 12 eV*
Deflection mode	3- 200 eV	0.5- 200 eV	0.5- 12 eV*

The DA30-L is available in a model specifically developed for ultra high resolution at the lowest kinetic energies, DA30-L-8000. This is the model of choice for customers who wish to perform ultra high resolution ARPES measurements below 3 eV kinetic energy. The DA30-L-EXT is a version featuring the lower kinetic energy range but without the 8000-version electronics, and hence shares the resolution guarantee with DA30-L.

* A UPS upgrade is available offering a mode extending the kinetic energy range to 100 eV

Deflection ready models
All of the DA30 models are available in deflection ready versions. These models are mechanically prepared for deflection, but delivered without deflection electronics. The upgrade to full deflection capability can be done at any time at site. The performance of these models are identical to the deflection counterparts, except that deflection modes are unavailable.

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