Research Equipment

- Atmosphere Control
- Thin Films & Coatings
- Solar Cells

IRASOL

General Catalog

CONTENTS

GLOVEBOX

Mini-computer-based glovebox with remote access

OVERVIEW

GLX-280AS is a mini-computer controlled glovebox, allowing access and control of the system through the internet. The mini-computer controls the gas input/output and vacuum pump based on reading multiple sensors.
Five sensors are installed on the system: differential pressure sensor, absolute pressure sensor, oxygen sensor, humidity sensor and volatile organic compound (VOC) sensor.

One of the main features of the GLX-280AS
is the very low leakage rate. There are multiple pre-defined routines, including: Normal Operation, Sample Load, Sample Unload, Continuous Purge and Vacuum Purge, making the operation of the system very easy.

Besides, in the Manual Mode, one can manually control the valves for custom applications. The mini-computer saves the condition of the system at each second on memory, allowing to analyze the system for possible problems.

It is also possible to check the system through the internet.

FEATURES

- Mini-computer based control system
- Remote control of the system through the internet
- Multiple pre-defined operation routines for easy use of system
- Very low leakage rate
- Multiple electrical and gas ports
- O_2, H_2O, VOC, P and DP sensors installed on system
- Easy system troubleshooting by company through the internet

SPECIFICATIONS

GLX-280AS Technical Specifications	
Model	GLX-280AS
Glovebox size (l x w x h)	138 cm x 65 cm x 85 cm
Main chamber size (l x w x h)	82 cm x 60 cm x 70 cm
Loading chamber size	l = 33 cm, D = 20 cm (Volume = 8 lit)
Main chamber walls	Stainless steel, t = 1.5 mm
Glovebox window	Tempered glass, t = 10 mm
Glove Port	Round Al port, for 8 inch gloves
Shelves	2 shelves, 50 cm x 12 cm, mounted at different height
Gas Ports	KF-40 port (1x), 1/4 inch manual on/off valve (2x)
Gloves	l = 70 cm, D = 7 inch, t = 0.6 mm
Light	Warm white (1x), Cool white (1x)
Manual pressure gauge	2 manual pressure gauge: vacuum gauge (-1 - 1 bar), Input gas pressure gauge (0 - 10 bar)
Loading chamber doors	Outside door: rotation sliding, screw lock ; Inside door: Jack-lift, screw lock
Sensors	Oxygen sensor: Electrochemical, 0-100% , Resolution 0.1%
	Temperature sensor: Resolution 0.1 °C
	Humidity sensor: 0-100%, Resolution 0.1%
	Differential pressure sensor: 0-4000 Pa, Resolution 1 Pa
	Absolute pressure sensor: -1000 mbar - 1000 mbar, Resolution 2 mbar
	VOC sensor: 0-100 ppm, Resolution 1 ppm
Mini-computer and electronics system	7 inch touch LCD, Resolution 480x800
	Ethernet port, USB port, Wifi, Bluetooth
	Automatic saving of sensors and valves data (one dataset per second)
Software features	Automatic control of pressure by tuning the rate of gas input and exhaust
	Pre-defined routine for sample loading and unloading
	pre-defined routine for continuous or vacuum purging
	Manual mode to turn on/off the valves
	Automatic control of vacuum pump
	Online display of the sensor values
	Internet access and control of the system
Electric ports	4 banana plug connections
Pneumatic system	Electric valves, 1/4 inch and 1 inch.
	Pressure regulator 0-10 bar at the gas input line
	Stainless steel bellow for vacuum connections
	Exhaust foot pedal (to ease of working with gloves)
Vacuum pump	Power: 1/4 HP, Max flow: 50 L min^{-1}
Power	Single phase, 220 VAC, 1000W
	16A surface socket inside main chamber (2x)
	6 A circuit breaker for electronic system
	6 A circuit breaker for electric valves
	16 A circuit breaker for the surface sockets
	Safety switch
Weight	175 Kg

LITHIUM BATTERY GLOVEBOX

Glovebox with oxygen and moisture levels below 1ppm

OVERVIEW

Lithium battery glovebox ASP series possess a high efficiency gas purification system to reduce the moisture and oxygen levels in the chamber down to 1ppm. The glovebox is ideal for lithium ion battery fabrication, as well as other applications where ppm level moisture and oxygen are needed. The closed cycle purification system removes oxygen and moisture, as well as organic vapors (VOCs) and dust particles. All the processes are controlled using a PLC and a dedicated software on a 10 inch HMI display. The system can be monitored and debugged over internet.

FEATURES

- Oxygen and moisture removal to below 1 ppm
- PLC control system and a dedicated software
- Removal of organic vapors (VOC) and dust particles
- Regeneration of moisture and oxygen absorbers
- Applicable for positive and negative pressures

SPECIFICATIONS

GLX-600ASP Technical Specifications		
Main Chamber	Glovebox size (l x w x h)	200 cm x 75 cm x 195 cm
	Main chamber size (l x w x h)	110 cm x 70 cm x 80 cm
	Main chamber walls	Stainless steel 304, t = 3 mm
	Glovebox window	Tempered glass, t = 10 mm
	Glove Port	Round Al port, for 8 inch gloves
	Shelves	2 shelves, 60 cm x 20 cm, mounted at different height
	Gas Ports	KF-40 port (4x), 1/4 inch manual on/off valve (2x)
	Gloves	Butyl gloves, l = 32 inch, D = 8 inch, t = 0.4 mm
	Light	Warm white (1x), Cool white (1x)
	Electric ports	4 banana plug connections 2 BNC Connections 1 Power outlet, 220 V, 16 A
Antechambers	Dimension	Large vacuum chamber: a cylinder with a length of 50 cm, diameter: 30 cm Small vacuum chamber: a cylinder with a length of 30 cm, diameter: 13 cm
	Loading chamber doors	Outer and inner door of large vacuum chamber with lifting mechanism Outer and inner door of small vacuum chamber with hinged mechanism
	Control system	The pressure inside each of the large and small vacuum chambers is indicated by a hand gauge and the pressure information is digitally transmitted to the PLC by a pressure transmitter and displayed on the HMI. The process of vacuuming and gassing the vacuum chambers is done automatically and according to the defined scenarios, and the corresponding process is displayed on the HMI. The user is able to view the pressure of the containers online.
Sensors	Temperature sensor	Resolution 0.1 °C
	Differential pressure senor	0-4000 Pascal, precision: 1 Pascal
	Pressure sensors (2x)	-1000 mbar - +1000 mbar
	Pressure regulator at the inert gas input line	0-18 bar
	VOC sensor	Solid state sensor, Indicator
Analyzers	Oxygen analyzer	Micro-fuel cell sensor
	Humidity analyzer	Capacitive sensor
Display	10 Inch Capacitive Touch Screen HMI Panel	
Software	Adjusting the pressure of main chamber between 10- mbar and 10+ mbar Automatic controlling the vacuum of chambers and adjusting the desired pressure Independent program to enter parts and materials into the main chamber (Sample Load) Independent program to remove parts and materials from inside the main compartment (Sample Unload) Independent program to purge the main chamber (Continuous Purge) Adjusting and changing all parameters of programs and scenarios (Setting) Manual turning off and on all valves and also through touch monitor (Manual Operation) Independent manual and automatic program for the regeneration of absorbents. Turning the vacuum pump on and off intelligently through the software and switchboard Possibility of switch on and off the purifier system and adjust the intensity of purifier system Display of oxygen and humidity in ppm and percentage Ability to issue commands and open and close programs using the pedal Remote controlling and monitoring using LAN cable Ability to define countless user codes, passwords and access levels	

GLX-600ASP Technical Specifications-Continued		
Purifier Unit	Particle Filter	HEPA
	VOC absorber	Activated carbon
	O2 absorber	Cu-based
	Humidity absorber	Molecular sieve
	Blower	Variable up to 15 m3/h
	Connections	KF40
	Final O2 concentration	< 1ppm
	Final humidity concentration	< 1ppm
power	Single phase, 220V, 16A	
Weight	410 Kg	

IRASOL SURFACE

UV-OZONE SURFACE TREATMENT SYSTEM

Rotating bed UV-Ozone with uniform and high intensity treatment

OVERVIEW

UV-Ozone processing is an essential treatment in fabrication of devices such as LEDs and solar cells, as well as many other cleaning and functionalization applications. It works based on a synergic effect of UV irradiation (254 nm) and ozone (generated by 185 nm radiation), to provide a highly intense oxidizing condition. The intensity of UV and the concentration of ozone are, however, highly non-uniform across the substrate holder; more intense near the lamp sources. This results in irreproducible device performance. One of the unique features of UZ-1929R series is the rotating bed, which provides uniform exposure of samples to UV and ozone. Besides, these series are designed for high intensity UV-Ozone, leading to shorter process time.

FEATURES

- Uniform exposure to UV-Ozone using a rotating bed
- Rapid processing by high intensity UV and small lamp-sample spacing
- Easy sample loading by sliding tray mechanism
- No UV and ozone leakage through dedicated sealing
- Rapid drain of ozonated air upon sliding out the sample tray
- LED signs, indicating the failed UV lamps to be replaced
- Useful for samples sizes up to 6 mm thickness and 180 mm length
- Ideal for cleaning substrates, including glass, silicon and GaAs
- Useful for improving adhesion to plastics and creating thin oxide on silicon or other materials

SPECIFICATIONS

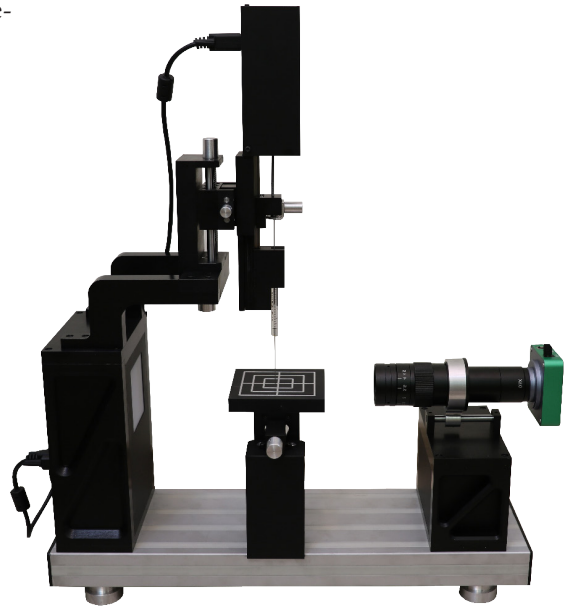
UZ Technical Specifications	
Model	UZ-1929R
UV lamp type	Low pressure mercury quartz UV lamp
UV lamp dominant wavelengths	185 nm, 254 nm
UV lamp dimensions	10 cm × 19 cm
Ozone generating lamp	220 V , 9 * 6 W Hg lamp
Power supply	220 V , 50-60 Hz
Max run time	99 hours
Safety features	Exhaust fan, electrical fuse
Sample holder	Sliding tray equipped with a rotating bed
Size of rotating bed	D = 180 mm
Max. recommended substrate size	180 mm × 180 mm × 6 mm (the vertical space can be increased up to 10 mm, by request)
Dimensions (WxHxD)	30 cm × 30 cm × 30 cm
Weight	15 Kg

CONTACT ANGLE MEASUREMENT SYSTEM

Semi-automatic contact angle measurement

OVERVIEW

CA-500A is an economic semi-automatic contact angle measurement system, based on a static Sessile drop method (upgradable to dynamic).



FEATURES

- Static sessile drop contact angle measurement
- Software control of dispenser
- 32 Mega pixel camera
- Manual fitting and measurement of droplet contact angle
- Accurate and easy to use

SPECIFICATIONS

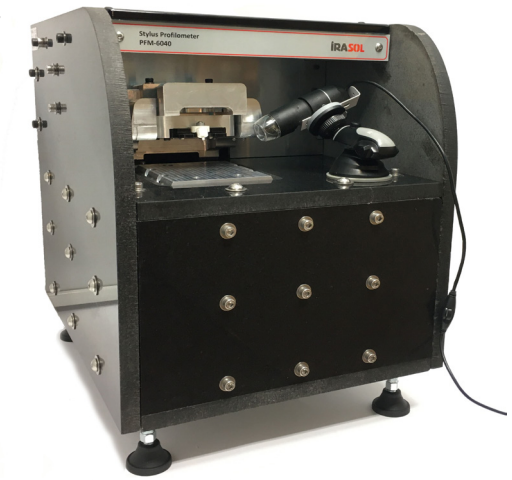
CA Technical Specifications	
Model	CA-500A
Measurement method	Static Sessile drop
Analysis method	Manual curve fit analysis
Measurement range	0-180 degrees
Resolution	0.01 degree
Accuracy	0.1 degree
Camera	High performance CMOS Sensor, 32 Megapixel & 140x magnification, Video 30 frame per second
Lighting	LED Based diffused lighting mechanism; Light intensity can be varied using software
Dispenser	Automated dispenser with precision of 0.5 microliter; a 50 microliter syringe is provided with the system, (Compatible with 20-100 microliter syringes)
Dispenser movement (z)	5.6 cm
Sample stage movement (x, y, z)	10 cm x 2.6 cm x 5.6 cm
Inlet Power	100-240 VAC, 50-60 Hz
Dimensions (l x w x h)	51 cm x 16 cm x 65 cm
Weight	10 Kg

STYLUS PROFILOMETER

High-precision capacitance sensor for Nanometric roughness

OVERVIEW

PFM-6020 and PFM-6040 are 1D profilometers for measuring surface roughness, step height and layer thickness. The instrument provides 100 µm- 2mm measuring range in the z-direction with a best precision of 50 nm. PFM-6040 includes some features to enhance the user experience such as motorized sample stage, motorized slope correction to improve mesurement accuracy and stylus low force option. The software controls the measurement process and contains graph leveling, analysis functions to analyze step height, roughness, slope and distance.



FEATURES

- High precision capacitive sensor
- High vertical resolution
- Long scan profiler up to 30 mm
- Low force stylus option

SPECIFICATIONS

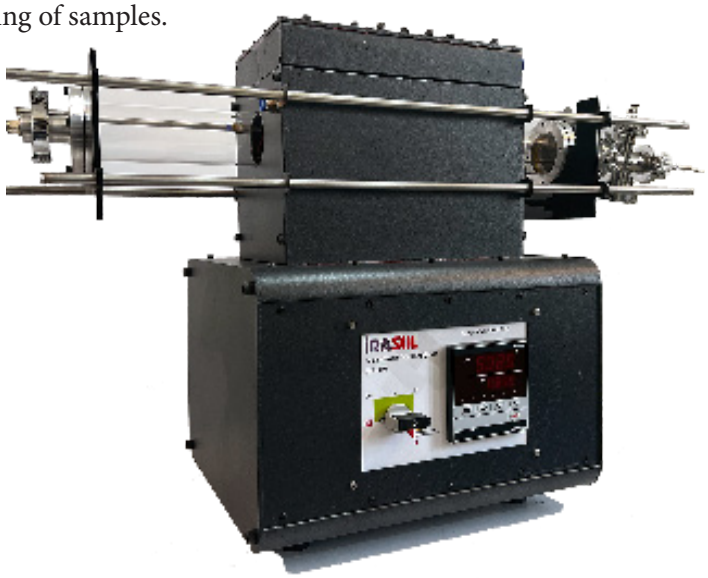
PFM Technical Specifications			
Model		PFM-6020	PFM-6040
Measurement technique	Contact stylus profilometry	√	√
Profilometry measurement	1-Dimensional surface profile measurement	√	√
Tip view camera	640*480 pixel, 50-500X Magnification, Focusable digital camera	√	√
Stylus sensor	Capacitive displacement sensor	√	√
Stylus approach	Automated stylus approach system	√	√
Sensor calibration	Automated calibration system	√	√
Stylus motion	x and z axis motorized motion	√	√
Low force option	Stylus-on-sample force adjustment system	-	√
Sample stage	z axis motorized stage	-	√
Max. wafer size	120 mm	√	√
Max. scan course	3 cm	√	√
Data points per scan	Max. 10000	√	√
X-Scan steps	1.3 µm	√	√
Step height accuracy *	50 nm	√	√
Software slope correction		√	√
Hardware slope correction system	Motorized slope correction	-	√
Vertical range	± 200 µm (± 100 µm - ± 1mm optional)	√	√
Max. sample height	45 mm	√	√
* Best step height measuring accuracy:	50-200 nm, based on sensor measuring range.		

RAPID THERMAL PROCESSING (RTP)

Rapid visible/IR light heating for lab-scale samples

OVERVIEW

RTP-1SX is a tube furnace with irradiation heating of samples and low heat capacity body, facilitating rapid heating and cooling of samples. The heating temperature and time can be set, and the atmosphere can be controlled, i.e. inert gas or vacuum. The irradiation is provided by maximum of 4 halogen lamps, each 1000 W. The trapped light inside the tube provides high energy concentration for rapid heating of samples.



FEATURES

- Heating rate up to 900 °C/min
- Max temperature up to 700 °C
- Easy replace of heating elements
- Heating in controlled atmosphere
- Selection of heating power up to 4000 W

SPECIFICATIONS

RTP Technical Specifications

Model		RTP1-SV	RTP1-SW
Furnace structure	Double layer Aluminum or Steel casing with air cooling keeps furnace surface temperature lower than °70C. Without any extra insulating	√	√
	Aluminum casing with water and air cooling keeps furnace surface temperature lower than °70C. Without any extra insulating	-	√
Heating Elements	1000 W halogen lamps (4x) Dia. = 10 mm, L=190 mm, Heated Length =225mm Standard working life: 2000 hrs (halogen lamp is consumable)	√	√
Heating zone	150 mm length with 100 mm constant temperature zone within ± °5 C uniformity	√	√
Working Temperature	for < 4 minute (Note: For this temperature, you should be careful about your quartz tube quality that can be stable at this temperature near softening point of quartz glass - Available by 4 lamps and light graphite box)	700 °C Max.	850 °C Max.
	for < 8 minutes (Available by 4 lamps)	650 °C Max.	800 °C Max.
	for < 20 minutes for < 60 minutes	600 °C Max.	750 °C Max.
	for < 60 minutes	550 °C Max.	-
	for Continuous	450 °C Max.	700 °C Max.
Max. heating rate	700 °C/min (Dependent on heat capacity and light absorption of the holder ,number of lamps that are on appropriate to electrical network capacity)	√	√
Max. Cooling rate	150 °C/min (Dependent on heat capacity and light absorption of holder and gas inserted into the tube)	√	√
Temperature control	Proportional-Integral-Derivative (PID) controller	√	√

RTP Technical Specifications (Continued)			
Model		RTP1-SV	RTP1-SW
Quartz Tube & Sample Holder	Quart Tube Size: 800 mm Length - O.D and I.D >> The graphite sample holder is removable from the flange for using the RTP furnace for other purposes.	38 mm O.D 36 mm I.D	60 mm O.D 55 mm I.D
Sample holder	Optional: Graphite sample holder for samples not larger than 1.4 cm in size.	√	√
Max sample size	(depending on thickness of sample holder) for direct use without sample holder	19× 14 mm^2	55× 100 mm^2
Power input	220 AC, 50 Hz single phase or 3 phase (25 A)V	√	√
Water circulation system for body cooling		-	√
Flow-meter (Optional)	One flow meter is installed on the front panel for adjusting the gas flow from 1000-50 sccm	Optional	Optional
Atmosphere		Air, Vacuum, Gas static, Gas flow	Air, Vacuum, Gas static, Gas flow
Accessories (Optional)	Vacuum pump, Vacuum Gage, special Graphite box, Flow-meter, Programmable PID controller	√	√
Safety	Thermal Safety system for auto-deactivate setup when the temperature of setup body increase more than acceptable temperature Residual Current Devices (RCD)	√	√

TINPLATE MEASUREMENT SYSTEM

Fast and reliable electrochemical method for tin coating thickness measurement

OVERVIEW

TMS-200 tinplate coating measurement system determines the quantity of free tin, alloyed tin, and total tin according to A630-16a standard. It includes an electronic box, an electrolyte container, and a flat cell along with two reference and auxiliary electrodes. Measurement is made by applying a constant current of 100 milliamps in the presence of 1 normal hydrochloric acid as the electrolyte, and the voltage values are monitored versus time. According to the standard, the times required for the stripping of free metal tin and tin alloy are measured and finally the quantity of tin is reported.

FEATURES

- Electrochemical measurement of the quantity of tin coating based on A630-16a standard
- Rapid load/unload of plate samples using a clamp system
- Easy and quick fill/drain of the flat cell using pump and solenoid valve
- Closed cycle for efficient use of acid electrolyte
- Dedicated software with automatic data saving

SPECIFICATIONS

TMS Technical Specifications	
Model	TMS-200
Measurement method	Chrono-potentiometry
Electrode connections	3
Potential range	3 V
Maximum current	500 mA
Current resolution	0.1 mA
Sample load/unload	Flat cell with push/pull clamp
Input voltage	100-240 V, 50-60 Hz
Computer interface	USB 2.0
Controle software	STMS-100.0.0.3
Software requirements	OS: Windows 2010 or later
Dimensions (l x w x h)	70 cm x 25 cm x 75 cm
Weight	20 Kg

IRASOL PV

IV-TRACER

Affordable, high-precision for standard electrochemical techniques

OVERVIEW

I-V tracer is an ideal solution for current-voltage measurement of solar cell devices both in dark and under solar simulated light. Some important parameters such as short circuit current (Jsc), open circuit voltage (Voc) and fill factor (ff) can be obtained using I-V curve. The applied voltage range is 5± V and the scan rate is adjustable.

SPECIFICATIONS

IV-Tracer Techincal Specifications	
Model	IV-201
Electrode connections	2
Potential range	± 5 V
Potential resolution	1 mV
Maximum current	1 A
Current range	Three manually set ranges: 0.5, 5 and 50 mA
Current resolution	Min. resolution: 1 nA
Input voltage	100-240 V AC (50-60 Hz)
Computer interface	USB 2.0
Control software	IVS-201.0.0.1
Software requirement	OS: Windows 10
Methods	Linear sweep voltammetry (IV) and Cyclic voltammetry (CV)

SOLAR CELL EXTERNAL QUANTUM EFFICIENCY MEASUREMENT SYSTEM (IPCE)

Economical and Semi-automatic system

OVERVIEW

IRASOL's IPCE-020 is an optimized LED-based system that is economic and compact, well suited for lab-scale solar cell characterization. In IPCE-020 innovative design, the quasi monochromatic light is provided using single wavelength LEDs that cover spectral range from 370 nm to 940 nm. This results in a compact and easy-to-use system. It is low-weight and requires no optical bench or optical alignment and setup.
The intensity of LED light is considerably important in solar cells in which the current collection efficiency depends on light intensity.
IPCE-020 is well-suited for new-generation solar cells including perovskite and dye solar cells, but it can be safely used for other types of solar cells.

FEATURES

- Automated IPCE measurement for lab-scale solar cells
- LED-based light source with 19 individual wavelengths
- Covering spectral range from 370 nm to 940 nm
- Containing a calibrated reference cell installed on the system
- Small, low cost and robust system
- Long-life LED light source (compared to conventional Xe lamps)
- No need for optical bench and optical alignment
- Ideal for perovskite and dye solar cells, as well as other types of solar cell

SPECIFICATIONS

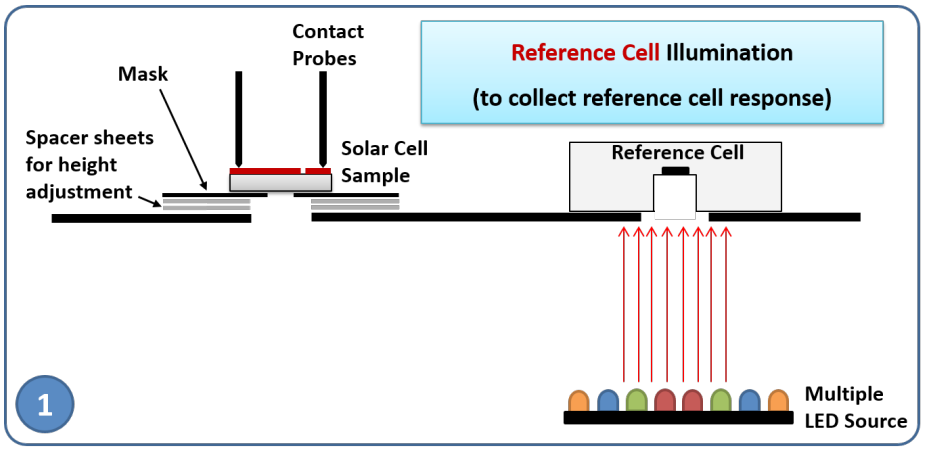
IPCE-020 Technical Specifications	
Wavelength Points (nm)	370, 400, 420, 450, 465, 505, 530, 570, 595, 610, 625, 660, 700, 730, 765, 800, 845, 895, 940
Reference Cell	Silicon PN photodiode (area: 0.073 cm^2)
Power Supply	12 VDC, 2A (Input: 100-240 VAC)
Computer Interface	USB 2.0
Solar Cell Active Area	0.01 to 0.5 cm^2 (0.05 to 0.3 cm^2 is preferred)
Minimum Requirement for Solar Cell Sample	J_{sc} (@AM1.5) > 1 mA/cm^2 (depends on cell area and wavelength)
Dimension (LxWxH)	61 cm × 30 cm × 19 cm
Weight	9.4 Kg

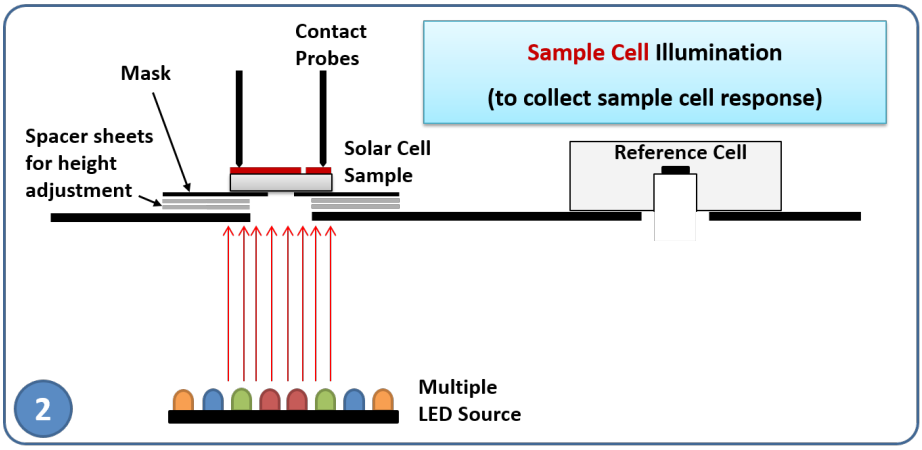
HOW IT WORKS

In IPCE-020 a full LED light source is utilized. Each category of LEDs produces quasi-monochromatic light which is used for the measurement.

There are 19 types of LEDs with the same number of wavelengths covering 370-940 nm range.

Measurement method for the IPCE-020 system is schematically shown in the following scheme. For each run of measurement, the short circuit current of the reference cell is measured first to determine the light intensity for each wavelength. After this stage, the sample is pushed above the LED lamp and short circuit current measurement is made for the sample.





UNIVERSAL SOLAR CELL TESTER

A comprehensive package of characterizations for lab-scale solar cells

OVERVIEW

The universal solar cell tester consists of a solar simulator and I-V measurement module, that allows various measurements at different temperatures and light intensities under controlled atmosphere conditions. The solar simulator includes an all-LED source with AM1.5 spectrum, according to IEC60904-9.
Although perovskite solar cells have a record efficiency of more than 25%, there are still problems of thermal stability, light stability, hysteresis, ion migration, and so on. By performing a wide range of measurements that are usually taken in laboratories with various equipment and methods, this system provides quick feedback for the evaluation and optimization of perovskite solar cells on a laboratory scale.

FEATURES

- Including solar simulator, I-V measurement module, temperature and atmosphere control module and comprehensive measurement software
- Measurement of solar cell characteristics in the temperature range of 5 °C-75 °C
- Measurement under different light intensities 0.1 – 1 Sun
- The possibility of evaluating the thermal and optical stability of peovskite cells
- Comprehensive software, with automatic calculation of relevant quantities in each measurement
- Possibility of measurement under controlled atmosphere

A comprehensive package of characterizations for lab-scale solar

Univeral Solar Cell Tester Specifications	
Model	UPT-100
Light source	Multiple LED source
Wavelength range	400-1000 nm
Non-uniformity of irradiance	< 2% (Class A)
Spectral match	< 5% (Class A+)
Temporal instability	< 0.5% (Class A)
Direction of illumination	Source down, sample top
Sample size	Max 28 mm
Lamp intensity adjustment	0.1 Sun- 1.0 Sun
Sample temperature sensing	Hot-plate sensor, IR pyrometer sensor
Thermal Protection	Heat sink temperature
I-V tracer voltage range	± 5 V
Voltage set resolution	1 mV
Maximum current	1 A
Current range	50 mA, 5 mA, 0.5 mA
Current resolution	%0.001 of current range (22-16 bit ADC)
Input voltage	220 VAC (60-50 Hz)
Computer interface	USB
Control software	UPTS-100.0.0
Measurement methods	Current-voltage/light Current-voltage/dark Variable light intensity MPP tracking Voc decay Stability test Thermal response
Software requirement	OS: Windows 10

FTO, ITO & COATED ELECTRODES

IRASOL supplies different options of conductive glass (glass/ITO) at different sizes. It also provides different coated electrodes on glass/ITO substrates.

Conductive glass: Glass/ITO
Electrodes: TiO_2 blocking layer electrode| ZnO blocking layer electrode | Transparent meso-TiO_2 electrode | Transparent/Reflector TiO_2 electrode | Pt electrode

Glass/ITO

]Indium tin oxide (ITO) conductive glass

ITO (indium tin oxide) coated glass is the most common transparent conductive film in various devices. It is also used in solar cells, for instance, in p-i-n perovskite solar cells. It should be noted that the sheet resistance of ITO may change upon heat treatment.

ITO Technical Specifications		
Glass thickness: 1.1 mm	Packaging and Order Number	
Sheet Resistance: 8-10 Ω/□	TCO-ITO-14MM-20	14×14 cm^2
	TCO-ITO-20MM-20	20×20 mm^2
	TCO-ITO-E-14MM-20	14×14 cm^2 -Etched
	TCO-ITO-E-20MM-20	20×20 mm^2 -Etched

TiO_2 Blocking Layer Electrode

Clear TiO_2/FTO layers as starting electrodes of for dye and perovskite solar cells

In many types of solar cells, the first layer is a blocking layer which thoroughly covers the FTO substrate. A thin layer of TiO_2 is the most commonly used blocking layer and the films are best deposited by spray pyrolysis. TiO_2 blocking layer electrode is a Glass/FTO substrate deposited by a thin layer of TiO_2.

ELD-TBL Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: TiO_2 thin film	ELD-TBL-20	20
Deposition method: Spray pyrolysis		
Thickness: 50-70 nm		
Color: Transparent		

ZnO Blocking Layer Electrode

Clear ZnO/FTO layers as starting electrodes of for dye and perovskite solar cells

In many types of solar cells, the first layer is a blocking layer which thoroughly covers the FTO substrate. ZnO blocking layer electrode is a Glass/FTO substrate deposited by a thin layer of ZnO using spray pyrolysis.

ELD-ZBL Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: ZnO thin film	ELD-ZBL-20	20
Deposition method: Spray pyrolysis		
Thickness: <100 nm		
Color: Transparent		

Transparent meso-TiO_2 Electrode

A transparent meso-TiO_2 layer on FTO for DSSC fabrication

Transparent meso-TiO_2 electrode contains Glass/FTO which is coated with several micrometer transparent layer of meso-TiO_2. It is used to fabricate the photo-anode of dye sensitized solar cells. Before using the electrode it is recommended to heat the electrode at around 500 °C for a few minutes in a furnace.

ELD-20T Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: meso-TiO_2	ELD-20T-20	20
Deposition method: Screen print		
Thickness: ~ 6-7 µm		
Color: Transparent		

Transparent / Reflector TiO_2 Electrode

A transparent / Reflector TiO_2 double layer on FTO for DSSC fabrication

Transparent /reflector TiO_2 film contains ~5 µm of reflector TiO_2 particles and ~7 µm layer of TiO_2 nanoparticles with average size of 20 nm, deposited on FTO glass. The scattering layer increases light harvesting efficiency. This electrode can be used as a standard photo-anode to evaluate dye molecules, quantum dots, electrolyte and different cathodes for dye sensitized solar cells. Annealing at 500 °C is recommended prior to use.

ELD-TR Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: meso-TiO_2 / Reflector Anatase TiO_2	ELD-TR-20	20
Deposition method: Screen print		
Thickness: ~ 10-12 µm		
Color: White		

Pt Electrode

Pt nanoparticle layer on FTO as counter electrode of DSSCs

Platinum electrode containing Pt nanoparticles on FTO glass is applied as cathode for dye-sensitized solar cells. Note that annealing at 460 °C for 15 min is required prior to use.

ELD-PT Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: Pt nanoparticles	ELD-PT-20	20
Deposition method: Screen print		
Thickness: < 10 nm		
Color: Light gray		

Inks and Pastes

IRASOL, in collaboration with partner labs, has developed various inks and pastes, mainly used and optimized for solar cells fabrication. Inks can be applied on the surface using spin coating, spray and other printing techniques. Pastes can be applied mainly by blade coating or screen printing.

METAL INKS AND PASTES:

Gold ink | Tetrachloroauric acid | Silver ink | Silver nanowire ink | Pt paste

CARBON INKS AND PASTES:

Graphene oxide ink | Carbon paste

METAL OXIDE PASTES:

TiO_2 Paste- Transparent | TiO_2 Paste- Reflector Anatase | TiO_2 Paste- Reflector Rutile | TiO_2 Paste- Reflector Rutile@SiO_2

METAL OXIDE INKS:

Crystalline aqueous TiO_2 sol | Amorphous aqueous TiO_2 sol | Acidic aqueous TiO_2 sol | Crystalline TiO_2 sol in ethanol

NON-OXIDE INKS AND PASTES:

$CuInS_2$ ink , $CuInGaS_2$ ink

Gold Ink

Au stable ink to deposit Au films

Gold ink is an stable dispersion of gold nanoparticles dispersed in toluene. This ink can be used for deposition of Au electrodes for perovskite solar cells or other devices.

INK-50AU Technical Specifications		
Nanoparticles: Au	Packaging and Order Number	
Particle Size: Avg. 5-6 nm	INK-50AU-1ML	1 mL
Concentration: 15%		
Physical Form: Liquid dispersion		
Color: Dark red-brown		
Solvent: Toluene		
Storage: 2-8 °C		

Tetrachloroauoric Acid ($HAuCl_4$)

Au precursor solution

$HAuCl_4$ is the conventional source of Au, for the synthesis of Au nanoparticles or thermal deposition of Au film.

PRE-HAUCL Technical Specifications		
Material: $HAuCl_4$	Packaging and Order Number	
Assay: >99.5%	PRE-HAUCL-10ML	10 mL
Concentration: 100 mg/ml		
Physical Form: Liquid solution		
Color: Yellow		
Solvent: H_2O		

Silver Ink

Silver conductive ink for wiring and metal contact

Silver ink consists of a concentrated Ag nanowire dispersion in H_2O, suitable for printing conductive wires and films.

AG INK Technical Specifications		
Particles: Ag Nanowires	Packaging and Order Number	
Particle Size: D ~ 100 nm, L < 10 µm	INK-100AG-1G	1 g
Concentration: 25-30 wt%	INK-100AG-5G	5 g
Physical Form: Liquid dispersion	INK-100AG-10G	10 g
Color: Gray		
Solvent: H2O		
Shelf Life: 2 month		
Curing Temperature/ Time: 100 °C /20 min		
Resistivity (mΩ/sq/40µm): ≤ 85 at 25°C, ≤ 65 at 100°C, ≤ 40 at 250°C		
Storage: < 5 °C		

Silver Nanowire Ink

Silver nanowire ink to deposit transparent conductive electrodes

Silver nanowire ink consists of a dilute Ag nanowire dispersion in ethanol, designed for deposition of transparent conductive films. It can be sprayed or spin coated on a substrate.

AGW INK Technical Specifications		
Particles: Ag nanowires	Packaging and Order Number	
Particle Size: D ~ 100 nm, L > 10 µm	INK-100AGW-10ML	10 mL
Concentration: 0.1 wt%	INK-100AGW-20ML	20 mL
Physical Form: Liquid dispersion		
Color: Gray		
Solvent: Ethanol		

Pt Paste

Pt containing paste to deposit Pt nanoparticle electrodes

Pt paste contains H_2PtCl_6 as Pt source in a paste containing solvent and binder. The paste can be easily applied by blade coating or screen printing. After thermal treatment a uniform thin layer of Pt nanoparticles is formed on the surface. Conventionally, Pt paste is applied on glass/FTO substrate acting as counter electrode of dye sensitized solar cells with high electrocatalytic activity.

PST-PT Technical Specifications		
Pt source: H_2PtCl_6	Packaging and Order Number	
Concentration: 0.3%	PST-PT-1G	1 g
Physical Form: Paste	PST-PT-5G	5 g
Color: light Yellow	PST-PT-10G	10 g
Storage: Dark 2-8 °C	PST-PT-20G	20 g

Carbon Paste

Terpineopl based carbon paste as a conductive electrode

The carbon paste contains graphite and carbon black as carbon source, terpineol solvent and other additives and binders. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated and at below 400 °C the binder is removed.

PST-100C Technical Specifications		
Carbon source: Graphite, Carbon black	Packaging and Order Number	
Concentration of carbon: 20%	PST-100C-1G	1 g
Physical Form: Paste	PST-100C-5G	5 g
Color: black	PST-100C-10G	10 g
Storage: 2-8 °C	PST-100C-20G	20 g

Carbon Paste

Toluene-based carbon paste suitable for perovskite solar cells

PST-101C is a conductive caron paste based on toluene solvent. It is ideal for perovskite solar cells and in applications were polar solvents should be avoided. One of the advantages of this carbon paste is that it forms a relatively flexible structure and can be used in flexible devices. The paste can be applied by methods such as blade coating. A post treatment at temperatures higher than 100 C will cure the paste.

PST-101C Technical Specifications		
Compoition: Graphite, Carbon Black, Binder, Additive in Toluene	Packaging and Order Number	
Concentration of carbon: 20%	PST-101C-1G	1 g
Physical Form: Paste	PST-101C-5G	5 g
Treatment: RT-100 °C for 30 min	PST-101C-10G	10 g
Sheet Resistance: 6.5-15 Ω for thickness of 70-140 µm	PST-101C-20G	20 g
Color: black		
Storage: 2-8 °C		

Nanocrystal TiO_2 Paste - Transparent

Ideal paste for meso-TiO_2 deposition

TiO_2 nanocrystal paste contains nanocrystals with narrow range of size distribution which form a very uniform and transparent film of mesoporous TiO_2. The paste can be applied as thick film by blade coating or screen printing for dye sensitized solar cells. For perovskite solar cells, the paste is first diluted and deposited as a thin film using spin coating. Thermal post-treatment is required after deposition. For thick films, a short ethanol vapor treatment helps level off the wet film. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C nanocrystals are sintered into a sufficiently good conductivity film.

PST-20T Technical Specifications		
Nanoparticles: TiO2 - Anatase	Packaging and Order Number	
Particle Size: Around 20 nm	PST-20T-1G	1 g
Concentration: 18%	PST-20T-5G	5 g
Physical Form: Paste	PST-20T-10G	10 g
Color: Cream	PST-20T-20G	20 g
Storage: 2-8 °C		

TiO_2 Paste – Reflector Anatase

A paste of anatase TiO_2 particles for reflection layer of DSSCs

This type of TiO_2 paste contains relatively large anatase TiO_2 particles, formed as a paste using a solvent and binder. The size of particles is larger than 100 nm and produce high light reflection, which is required for a reflector layer in dye sensitized solar cells. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C nanocrystals are sintered into a sufficiently good conductivity film.

PST-300A Technical Specifications		
Nanoparticles: TiO2 - Anatase	Packaging and Order Number	
Particle Size: >100 nm	PST-300A-1G	1 g
Concentration: 28 wt%	PST-300A-5G	5 g
Physical Form: Paste	PST-300A-10G	10 g
Color: White	PST-300A-20G	20 g
Storage: 2-8 °C		

TiO_2 Paste – Reflector Rutile

A paste of rutile TiO_2 particles for reflection layer of DSSCs

This type of TiO_2 paste contains relatively large rutile TiO_2 particles, formed as a paste using a solvent and binder. The particle size distribution is broad, with typical size of about 300 nm. Rutile TiO_2 has higher refractive index compared to anatase TiO_2, hence showing higher reflection of light. However, in dye sensitized solar cells the smaller bandgap of rutile may reduce the performance of device. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C particles are sintered.

PST-300R Technical Specifications		
Particles: TiO_2 - Rutile	Packaging and Order Number	
Particle Size: Around 300 nm	PST-300R-1G	1 g
Concentration: 28 wt%	PST-300R-5G	5 g
Physical Form: Paste	PST-300R-10G	10 g
Color: White	PST-300R-20G	20 g
Storage: 2-8 °C		

TiO_2 Paste – Reflector Rutile@SiO_2

A paste of rutile SiO_2 coated TiO_2 particles for reflection layer of DSSCs

This TiO_2 paste is essentially similar to rutile TiO_2 paste, however, the rutile particles are coated using a thin layer of SiO_2, in order to inhibit the electrical conductivity. In dye sensitized solar cells, a rutile@SiO_2 reflector layer only shows optical effect, and due to being an insulator, plays no electrical role in the solar cell device. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C nanocrystals are sintered into a sufficiently good conductivity film.

PST-400RS Technical Specifications		
Particles: TiO_2–Rutile coated with SiO_2	Packaging and Order Number	
Particle Size: 250-500 nm, SiO_2 shell: ~70 nm	PST-400RS-1G	1 g
Concentration: 28 wt%	PST-400RS-5G	5 g
Physical Form: Paste	PST-400RS-10G	10 g
Color: White	PST-400RS-20G	20 g
Storage: 2-8 °C		

TiO_2 Paste – Reflector Rutile@SiO_2

Paste of rutile SiO_2 coated TiO_2 particles for reflection layer of DSSCs

This TiO_2 paste is essentially similar to rutile TiO_2 paste, however, the rutile particles are coated using a thin layer of SiO_2, in order to inhibit the electrical conductivity. In dye sensitized solar cells, a rutile@SiO_2 reflector layer only shows optical effect, and due to being an insulator, plays no electrical role in the solar cell device. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C nanocrystals are sintered into a sufficiently good conductivity film.

PST-400RS Technical Specifications		
Particles: TiO_2–Rutile coated with SiO_2	Packaging and Order Number	
Particle Size: 250-500 nm, SiO_2 shell: ~70 nm	PST-400RS-1G	1 g
Concentration: 28 wt%	PST-400RS-5G	5 g
Physical Form: Paste	PST-400RS-10G	10 g
Color: White	PST-400RS-20G	20 g
Storage: 2-8 °C		

Standard Iodine-based Electrolyte

DSSC electrolyte in acetonitrile

Standard electrolyte contains I^-/I_3^- redox in acetonitrile solvent. With this electrolyte high current can be obtained with dye sensitized solar cell devices. However, acetonitrile is a low boiling point solvent and suitable sealing of cell is required.

ELT-ACN-I Technical Specifications		
Redox couple: I^-/I_3^-	Packaging and Order Number	
Solvent: Acetonitrile	ELT-ACN-I-1ML	1 mL
Additives: 8%	ELT-ACN-I-5ML	5 mL
Physical Form: liquid	ELT-ACN-I-10ML	10 mL

Crystalline Aqueous TiO_2 Sol

Nanocrystal TiO_2 stable neutral aqueous sol with no dispersing agent

Crystalline aqueous TiO_2 sol is a dispersion of TiO_2 nanoparticles in H_2O with neutral pH. The sol is electrostatically stable, without any carbon-containing dispersing agents. It forms uniform and adhering films due to the highly sol-gel active surface of nanoparticles.

SOL-30TC Technical Specifications		
Nanoparticles: TiO_2 – anatase	Packaging and Order Number	
Particle shape: spindle shape	SOL-30TC-10ML	10 mL
Particle Size: Around 30 nm (DLS)	SOL-30TC-50ML	5 x 10 mL
Concentration: 1 wt%		
Physical Form: Liquid dispersion		
Color: yellow		
Solvent: H_2O		
pH: neutral		
Ion conductivity: ~ 200 mS/cm		
Dispersing agent: No		

Amorphous Aqueous TiO_2 Sol

Amorphous TiO_2 stable neutral aqueous sol with no dispersing agent

Amorphous aqueous TiO_2 sol is a dispersion of very small TiO_2 nanoparticles in H_2O with neutral pH. The sol is electrostatically stable, without any carbon containing dispersing agents. It forms uniform and adhering films due to the highly sol-gel active surface of nanoparticles.

SOL-10TA Technical Specifications		
Nanoparticles: TiO_2 - amorphous	Packaging and Order Number	
Particle Size: <10 nm	SOL-10TA-10ML	10 mL
Concentration: 1 wt%	SOL-10TA-50ML	5 x 10 mL
Physical Form: Liquid dispersion		
Color: Slightly Yellow		
Solvent: H_2O		
pH: neutral		
Ion conductivity: ~ 200 mS/cm		
Dispersing agent: No		

Acidic aqueous TiO_2 Sol

Acidic dispersion of small TiO_2 nanoparticles

Acidic aqueous TiO_2 sol is a dispersion of small amorphous TiO_2 nanoparticles in H_2O with low pH. It can be used to form thin films of TiO_2.

SOL-10TAC Technical Specifications		
Nanoparticles: TiO_2- amorphous	Packaging and Order Number	
Particle Size: <10 nm (DLS)	SOL-10TAC-10ML	10 mL
Concentration: 1 wt%	SOL-10TAC-50ML	5 x 10 mL
Physical Form: Liquid dispersion		
Color: transparent		
Solvent: H2O		
pH: < 2		

Crystalline TiO_2 Sol in Ethanol

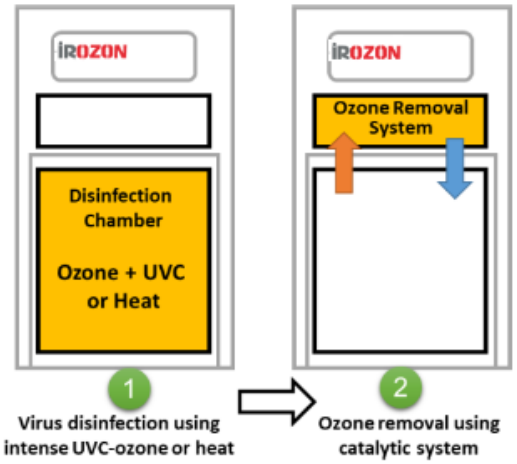
Ethanol dispersion of highly crystalline TiO_2 nanoparticles

Crystalline TiO_2 sol in ethanol is a dispersion of TiO_2 nanoparticles in ethanol. Nanoparticles are relatively mono-dispersed, with high crystallinity. It can be used to form thin films of highly crystalline TiO_2 nanoparticles.

SOL-20TET Technical Specifications		
Nanoparticles: TiO_2- Anatase	Packaging and Order Number	
Particle Size: Around 20 nm	SOL-20TET-10ML	10 mL
Concentration: 0.1 wt%	SOL-20TET-50ML	5 x10 mL
Physical Form: Liquid dispersion		
Color: White		
Solvent: Ethanol		

DRY DISINFECTION SYSTEM

In addition to UVC-ozone process, the system supports thermal disinfection process. It raises the temperature to 60 -55 °C for 45-10 min.
For many of virus and bacteria species this thermal dose is sufficient to kill them. In the meantime, forced air guarantees uniform temperature distribution in the chamber.



UDS Technical Specifications	
Model	UDS-400
UV-Ozone source	Low pressure mercury lamp, 18 W ×2
disinfection Mechanism	3UVC photonic disinfection, Ozone-UVC synergic oxidative disinfection, thermal disinfection (55 – 60 °C heat process)
Ozone Removal System	MnO_2-based ozone decomposition catalyst
Catalyst replacement	Not required. In case catalyst is deactivated, it is regenerated by pushing the Catalyst Regeneration button
Ozone Sensing	0.001 – 1000 ppm. Ozone sensor- low concentration, Ozone sensor- high con centration (Semiconductor based sensor), Plus optical ozone sensing
UV Sensing	UV sensor module, selective for UVC
Temperature/ Humidity Sensing	T: 0-60 °C, RH: 0-100%, temperature humidity sensor chip
Electronics	Microcontroller based. Automatic fault detection
Displayed Quantities	Ozone dose, UVC dose, Temperature, Humidity, Ozone high/safe alerts, Error alerts, System Status LEDs
UVS-Ozone Process Timing	2 min, 5 min, 15 min
Thermal Processing Timing	10 min, 25 min, 45 min
Typical Ozone Removal Time	2.5 min
Chamber Walls	Al UVC reflective sheets
Dimensions (w × d × h)	50 cm × 40 cm × 75 cm
Weight	30 Kg

$CuInS_2$ Ink

Stable dispersion to deposit high performance HTM layers

$CuInS_2$ nanoparticles dispersed in chloroform can be applied with high uniformity using spin coating. It is a p-type semiconductor and has been successfully used as an inorganic hole transporting material (HTM) of perovskite solar cells.

INK-20CIS Technical Specifications		
Nanoparticles: $CuInS_2$	Packaging and Order Number	
Particle Size: ~18 nm (DLS Analysis)	INK-20CIS-10ML	10 mL
Concentration: 30 mg mL^{-1}		
Physical Form: Liquid dispersion		
Color: Black		
Solvent: Chloroform		

$CuInGaS_2$ Ink

Stable dispersion to deposit an efficient absorbing layer of CIGS solar cells

$CuInGaS_2$ nanoparticles dispersed in chloroform can be applied with high uniformity using spin coating. It is a p-type semiconductor and has been successfully used as an absorbing layer of CIGS solar cells and inorganic hole transporting material (HTM) of perovskite solar cells.

INK-25CIGS Technical Specifications		
Nanoparticles: $CuInGaS_2$	Packaging and Order Number	
Particle Size: 20-30 nm (DLS Analysis)	INK-25CIGS-10ML	10 mL
Concentration: 25 mg mL^{-1}		
Physical Form: Liquid dispersion		
Color: Black		
Solvent: Chloroform		

Materials for Dye Sensitized Solar Cells

IRASOL and its partner labs have long experience with high-efficiency dye sensitized solar cells (DSSC) and have developed various materials and electrodes suited for research in the field of DSSC.

TiO_2: TiO_2 Paste- Transparent | TiO_2 Paste- Reflector Anatase | TiO_2 Paste- Reflector Rutile | TiO_2 Paste- Reflector Rutile@SiO_2

ELECTROLYTE: Standard iodine-based | High performance iodine-based | Low volatility iodine-based

ELECTRODES: TiO_2 blocking layer electrode| ZnO blocking layer electrode | Transparent meso-TiO_2 electrode | Transparent/Reflector TiO_2 electrode | Pt electrode

OTHER PASTES: Pt paste | Carbon paste

Nanocrystal TiO_2 Paste - Transparent

Ideal paste for meso-TiO_2 deposition

TiO_2 nanocrystal paste contains nanocrystals with narrow range of size which form a very uniform and transparent film of mesoporous TiO_2. The paste can be applied as thick film by blade coating or screen printing for dye sensitized solar cells.
For perovskite solar cells, the paste is first diluted and deposited as a thin film using spin coating. Thermal post-treatment is required after deposition. For thick films, a short ethanol vapor treatment helps level off the wet film. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C nanocrystals are sintered into a sufficiently good conductivity film.

PST-20T Technical Specifications		
Nanoparticles: TiO_2 - Anatase	Packaging and Order Number	
Particle Size: Around 20 nm	PST-20T-1G	1 g
Concentration: 18%	PST-20T-5G	5 g
Physical Form: Paste	PST-20T-10G	10 g
Color: Cream	PST-20T-20G	20 g
Storage: 2-8 °C		

TiO_2 Paste – Reflector Anatase

Paste of anatase TiO_2 particles for reflection layer of DSSCs

This type of TiO_2 paste contains relatively large anatase TiO_2 particles, formed as a paste using a solvent and binder. The size of particles is larger than 100 nm and produce high light reflection, which is required for a reflector layer in dye sensitized solar cells. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C nanocrystals are sintered into a sufficiently good conductivity film.

PST-300A Technical Specifications		
Nanoparticles: TiO_2 - Anatase	Packaging and Order Number	
Particle Size: >100 nm	PST-300A-1G	1 g
Concentration: 28 wt%	PST-300A-5G	5 g
Physical Form: Paste	PST-300A-10G	10 g
Color: White	PST-300A-20G	20 g
Storage: 2-8 °C		

TiO_2 Paste – Reflector Rutile

Paste of rutile TiO_2 particles for reflection layer of DSSCs

This type of TiO_2 paste contains relatively large rutile TiO_2 particles, formed as a paste using a solvent and binder. The particles size distribution is broad, with typical size of about 300 nm. Rutile TiO_2 has higher refractive index compared to anatase TiO_2, hence showing higher reflection of light. However, in dye sensitize solar cells the smaller bandgap of rutile may reduce the performance of device. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C particles are sintered.

PST-300R Technical Specifications		
Particles: TiO_2 - Rutile	Packaging and Order Number	
Particle Size: Around 300 nm	PST-300R-1G	1 g
Concentration: 28 wt%	PST-300R-5G	5 g
Physical Form: Paste	PST-300R-10G	10 g
Color: White	PST-300R-20G	20 g
Storage: 2-8 °C		

High Performance Iodine-based Electrolyte

DSSC electrolyte in acetonitrile/valeronitrile

High Performance electrolyte contains I^-/I^-_3 redox in acetonitrile/valeronitrile mixed solvent. Adding valeronitrile reduces the volatility of the electrolyte and improves the stability of cells.

ELT-AV-I Technical Specifications		
Redox couple: I^-/I_3^-	Packaging and Order Number	
Solvent: Acetonitrile/valeronitrile	ELT-AV-I-1ML	1 mL
Additives: ~ 10%	ELT-AV-I-5ML	5 mL
Physical Form: Liquid	ELT-AV-I-10ML	10 mL

Low Volatility Iodine-based Electrolyte

DSSC electrolyte in 3-methoxypropionitrile

This electrolyte contains I^-/I_3^- redox in 3-methoxypropionitrile solvent. This is a low volatility electrolyte and provides solar cells with high stability.

ELT-MPN Technical Specifications		
Redox couple: I^-/I^-_3	Packaging and Order Number	
Solvent: 3-methoxypropionitrile	ELT-MPN-I-1ML	1 mL
Additives: 27%	ELT-MPN-I-5ML	5 mL
Physical Form: Liquid	ELT-MPN-I-10ML	10 mL

TiO_2 Blocking Layer Electrode

Clear TiO_2/FTO layers as starting electrodes of for dye and perovskite solar cells

In many types of solar cells, the first layer is a blocking layer which thoroughly covers the FTO substrate. A thin layer of TiO_2 is the most commonly used blocking layer and the films are best deposited by spray pyrolysis. TiO_2 blocking layer electrode is a Glass/FTO substrate deposited by a thin layer of TiO_2.

ELD-TBL Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: TiO_2 thin film	ELD-TBL-20	20
Deposition method: Spray pyrolysis		
Thickness: 50-70 nm		
Color: Transparent		

ZnO Blocking Layer Electrode

Clear ZnO/FTO layers as starting electrodes of for dye and perovskite solar cells

In many types of solar cells, the first layer is a blocking layer which thoroughly covers the FTO substrate. ZnO blocking layer electrode is a Glass/FTO substrate deposited by a thin layer of ZnO using spray pyrolysis.

ELD-ZBL Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: ZnO thin film	ELD-ZBL-20	20
Deposition method: Spray pyrolysis		
Thickness: <100 nm		
Color: Transparent		

Transparent meso-TiO_2 Electrode

A transparent meso-TiO_2 layer on FTO for DSSC fabrication

Transparent meso-TiO_2 electrode contains Glass/FTO which is coated with several micrometer transparent layer of meso-TiO_2. It is used to fabricate the photo-anode of dye sensitized solar cells. Before using the electrode it is recommended to heat the electrode at around 500 °C for a few minutes in a furnace.

ELD-20T Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: meso-TiO_2	ELD-20T-1	1
Deposition method: Screen print	ELD-20T-5	5
Thickness: ~ 6-7 µm	ELD-20T-10	10
Color: Transparent	ELD-20T-20	20

Transparent / Reflector TiO_2 Electrode

A transparent / Reflector TiO_2 double layer on FTO for DSSC fabrication

Transparent /reflector TiO_2 film contains ~5 µm of reflector TiO_2 particles and ~7 µm layer of TiO_2 nanoparticles with average size of 20 nm, deposited on FTO glass. The scattering layer increases light harvesting efficiency. This electrode can be used as a standard photo-anode to evaluate dye molecules, quantum dots, electrolyte and different cathodes for dye sensitized solar cells. Annealing at 500 °C is recommended prior to use.

ELD-TR Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: meso-TiO_2 / Reflector Anatase TiO_2	ELD-TR-1	1
Deposition method: Screen print	ELD-TR-5	5
Thickness: ~ 10-12 µm	ELD-TR-10	10
Color: White	ELD-TR-20	20

Pt Electrode

Pt nanoparticle layer on FTO as counter electrode of DSSCs

Platinum electrode containing Pt nanoparticles on FTO glass is applied as cathode for dye-sensitized solar cells. Note that annealing at 460 °C for 15 min is required prior to use.

ELD-PT Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: Pt nanoparticles	ELD-PT-1	1
Deposition method: Screen print		
Thickness: < 10 nm		
Color: Light gray		

Pt Paste

Pt containing paste to deposit Pt nanoparticle electrodes

Pt paste contains H_2PtCl_6 as Pt source in a paste containing solvent and binder. The paste can be easily applied by blade coating or screen printing. After thermal treatment a uniform thin layer of Pt nanoparticles is formed on the surface. Conventionally, Pt paste is applied on glass/FTO substrate acting as counter electrode of dye sensitized solar cells with high electrocatalytic activity.

PST-PT Technical Specifications		
Pt source: H_2PtCl_6	Packaging and Order Number	
Concentration: 0.3%	PST-PT-1G	1 g
Physical Form: Paste	PST-PT-5G	5 g
Color: light Yellow	PST-PT-10G	10 g
Storage: Dark 2-8 °C	PST-PT-20G	20 g

Carbon Paste

Terpineopl based carbon paste as a conductive electrode

The carbon paste contains graphite and carbon black as carbon source, terpineol solvent and other additives and binders. The paste can be applied by blade coating or screen printing. By thermal treatment, at around 100 °C the solvent is evaporated and at below 400 °C the binder is removed.

PST-100C Technical Specifications		
Carbon source: Graphite, Carbon black	Packaging and Order Number	
Concentration of carbon: 20%	PST-100C-1G	1 g
Physical Form: Paste	PST-100C-5G	5 g
Color: black	PST-100C-10G	10 g
Storage: 2-8 °C	PST-100C-20G	20 g

Materials for Perovskite Solar Cells

IRASOL produces various precursors, inks and pastes which are used in the fabrication of perovskite solar cells (PSCs). The materials are developed by PSC experts and carefully produced and tested for use in PSCs.

PRECURSORS: PbI_2 | $PbBr_2$ | $PbCl_2$ | MAI | MABr | MACl | FAI

TiO_2: TiO_2 Paste- Transparent

HTM: $CuInS_2$ | $CuInGaS_2$

ELECTRODES: TiO_2 blocking layer electrode| ZnO blocking layer electrode/ Carbon paste

PbI_2 | Lead Iodide

Perovskite ink precursor

Lead iodide is a critical starting material in perovskite solar cells. The synthesis process is designed for high purity PbI_2 suited for high-efficiency solar cells. PbI_2 is soluble in solvents such as DMF and gamma-butyrolactone and can be applied on the surface using spin coating.

PER-PBI2 Technical Specifications		
CAS Number: 10101-63-0	Packaging and Order Number	
Physical Form: Powder	PER-PBI2-5G	5 g
Color: Yellow	PER-PBI2-10G	10 g
Molecular weight: 461.01 g/mol	PER-PBI2-20G	20 g
Density: 6.16 g/cm^3		

$PbBr_2$ | Lead Bromide

Perovskite ink precursor

Lead bromide is used in the perovskite formulations containing Br as anion. Our synthesis process is designed for high purity material suited for high-efficiency solar cells.

PER-PBBR2 Technical Specifications		
CAS Number: 10031-22-8	Packaging and Order Number	
Physical Form: Powder	PER-PBBR2-5G	5 g
Color: White	PER-PBBR2-10G	10 g
Molecular weight: 367.01 g/mol	PER-PBBR2-20G	20 g
Density: 6.66 g/cm^3		

$PbCl_2$ | Lead Chloride

Perovskite ink precursor

$PbCl_2$ is used to add Cl into the perovskite film. Cl is known to improve the crystallinity and diffusion length of perovskite films. Our synthesis process is designed for high purity material suited for high-efficiency solar cells.

PER-PBCL2 Technical Specifications		
CAS Number: 7758-95-4	Packaging and Order Number	
Physical Form: Powder	PER-PBCL2-5G	5 g
Color: White	PER-PBCL2-10G	10 g
Molecular weight: 278.1 g/mol	PER-PBCL2-20G	20 g
Density: 5.85 g/cm^3		

MAI | Methylammonium Iodide

Perovskite ink precursor

Methylammonium iodide is one is the main ingredients of conventional $CH_3NH_3PbI_3$ perovskites. Our synthesis process is designed for high purity material suited for high-efficiency solar cells.

PER-MAI Technical Specifications		
CAS Number: 14965-49-2	Packaging and Order Number	
Physical Form: Powder	PER-MAI-5G	5 g
Color: White	PER-MAI-10G	10 g
Molecular weight: 158.97 g/mol	PER-MAI-20G	20 g

MABr | Methylammonium Bromide

Perovskite ink precursor

Methylammonium bromide is used in perovskite formulations where adding MA as cation and Br as anion are required. In particular, it is one of the main starting materials in conventional three cation perovskites. Our synthesis process is designed for high purity material suited for high-efficiency solar cells.

PER-MABR Technical Specifications		
CAS Number: 6876-37-5	Packaging and Order Number	
Physical Form: Powder	PER-MABR-5G	5 g
Color: White	PER-MABR-10G	10 g
Molecular weight: 111.97 g/mol	PER-MABR-20G	20 g

MACl | Methylammonium Chloride

Perovskite ink precursor

Methyl ammonium chloride is mainly used to add Cl in the perovskite formulation. Cl is known to improve perovskite crystallinity and diffusion length. Our synthesis process is designed for high purity material suited for high-efficiency solar cells.

PER-MACL Technical Specifications		
CAS Number: 593-51-1	Packaging and Order Number	
Physical Form: Powder	PER-MACL-5G	5 g
Color: Colorless Crystals	PER-MACL-10G	10 g
Molecular weight: 67.52 g/mol	PER-MACL-20G	20 g

FAI | Formamidinium Iodide

Perovskite ink precursor

Formamidinium iodide is used in perovskite formulations containing FA as cation. FA and MA are the main organic cations in perovskites, while FA-based perovskites are generally more stable and produce better solar cell efficiencies. Our synthesis process is designed for high purity material suited for high-efficiency solar cells.

PER-FAI Technical Specifications		
CAS Number: 879643-71-7	Packaging and Order Number	
Physical Form: Powder	PER-FAI-5G	5 g
Color: White	PER-FAI-10G	10 g
Molecular weight: 171.97 g/mol	PER-FAI-20G	20 g

Nanocrystal TiO_2 Paste - Transparent

Ideal paste for meso-TiO_2 deposition

TiO_2 nanocrystal paste contains nanocrystals with narrow range of size which form a very uniform and transparent film of mesoporous TiO_2. The paste can be applied as thick film by blade coating or screen printing for dye sensitized solar cells.
For perovskite solar cells, the paste is first diluted and deposited as a thin film using spin coating. Thermal post-treatment is required after deposition. For thick films, a short ethanol vapor treatment helps level off the wet film. By thermal treatment, at around 100 °C the solvent is evaporated, at below 400 °C the binder is removed and at >500 °C nanocrystals are sintered into a sufficiently good conductivity film.

PST-20T Technical Specifications		
Nanoparticles: TiO_2 - Anatase	Packaging and Order Number	
Particle Size: Around 20 nm	PST-20T-1G	1 g
Concentration: 18%	PST-20T-5G	5 g
Physical Form: Paste	PST-20T-10G	10 g
Color: Cream	PST-20T-20G	20 g
Storage: 2-8 °C		

$CuInS_2$ Ink

Stable dispersion to deposit high performance HTM layers

$CuInS_2$ nanoparticles dispersed in chloroform can be applied with high uniformity using spin coating. It is a p-type semiconductor and has been successfully used as an inorganic hoe transporting material (HTM) of perovskite solar cells.

INK-20CIS Technical Specifications		
Nanoparticles: $CuInS_2$	Packaging and Order Number	
Particle Size: ~18 nm (DLS Analysis)	INK-20CIS-10ML	10 mL
Concentration: 30 mg mL^{-1}		
Physical Form: Liquid dispersion		
Color: Black		
Solvent: Chloroform		

$CuInGaS_2$ Ink

Stable dispersion to deposit high performance HTM layers

$CuInGaS_2$ nanoparticles dispersed in chloroform can be applied with high uniformity using spin coating. It is a p-type semiconductor and has been successfully used as an absorbing layer of CIGS solar cells and inorganic hole transporting material (HTM) of perovskite solar cells.

INK-25CIGS Technical Specifications		
Nanoparticles: $CuInGaS_2$	Packaging and Order Number	
Particle Size: 20-30 nm (DLS Analysis)	INK-25CIGS-10ML	10 mL
Concentration: 25 mg mL^{-1}		
Physical Form: Liquid dispersion		
Color: Black		
Solvent: Chloroform		

TiO_2 Blocking Layer Electrode

Clear TiO_2/FTO layers as starting electrodes of for dye and perovskite solar cells

In many types of solar cells, the first layer is a blocking layer which thoroughly covers the FTO substrate. A thin layer of TiO_2 is the most commonly used blocking layer and the films are best deposited by spray pyrolysis. TiO_2 blocking layer electrode is a Glass/FTO substrate deposited by a thin layer of TiO_2.

ELD-TBL Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: TiO_2 thin film	ELD-TBL-20	20
Deposition method: Spray pyrolysis		
Thickness: 50-70 nm		
Color: Transparent		

ZnO Blocking Layer Electrode

Clear ZnO/FTO layers as starting electrodes of for dye and perovskite solar cells

In many types of solar cells, the first layer is a blocking layer which thoroughly covers the FTO substrate. ZnO blocking layer electrode is a Glass/FTO substrate deposited by a thin layer of ZnO using spray pyrolysis.

ELD-ZBL Technical Specifications		
Substrate: Glass/FTO	Packaging and Order Number	
Coating: ZnO thin film	ELD-ZBL-20	20
Deposition method: Spray pyrolysis		
Thickness: <100 nm		
Color: Transparent		

Carbon Paste

Toluene-based carbon paste suitable for perovskite solar cells

PST-101C is a conductive caron paste based on toluene solvent. It is ideal for perovskite solar cells and in applications were polar solvents should be avoided. One of the advantages of this carbon paste is that it forms a relatively flexible structure and can be used in flexible devices. The paste can be applied by methods such as blade coating. A post treatment at temperatures higher than 100 C will cure the paste.

PST-101C Technical Specifications		
Compoition: Graphite, Binder, Additive in Toluene	Packaging and Order Number	
Concentration of carbon: 20%	PST-101C-1G	1 g
Physical Form: Paste	PST-101C-5G	5 g
Color: black	PST-101C-10G	10 g
Storage: 2-8 °C	PST-101C-20G	20 g

IROZON
DRY DISINFECTION SYSTEMS

DRY DISINFECTION SYSTEM

Virus disinfection of surfaces by intense Ozone + UVC or thermal process

OVERVIEW

UDS-400 is a dry disinfection system based on intense UVC and ozone exposure, with additional feature of heating. Disinfection protocols are carried out by the automated system via ozone and temperature sensors readings. A catalytic ozone removal system decomposes the remaining ozone after the disinfection process.

FEATURES

- Virus disinfection by intense UVC-ozone, or heat
- Decomposition of remaining ozone after the process
- Regeneration of ozone decomposition catalyst after deactivation
- Automated system control based on ozone and temperature sensors
- 50L double-wall process box with internal UVC reflectors
- Self-diagnostic system, indicating possible faults

APPLICATIONS

- Disinfection of medical parts and instruments
- Disinfection of paper, cash, money and plastic-ware
- Disinfection of glass, spoon, dishes, etc. in restaurants and hotels
- Disinfection of electronic utilities such as mobile and laptop
- Disinfection of home utilities, shoes, clothes and purchased items

HOW IT WORKS

UDS-400 is a system to disinfect the surface of objects using UVC-ozone or thermal process. It is aimed at dry disinfecting of objects. The UVC lamps produce simultaneous ozone and UVC dosing. The synergic effect of UVC and ozone provides a highly oxidative atmosphere that kills both viruses and bacteria on the surface.
Besides, UVC reflective walls trap the UVC photons inside the chamber and provide a relatively uniform and high -intensity UVC irradiation. UVC is known to disinfect by photonic absorption in the virus or bacteria. While UVC is only effective for the outer surface of objects exposed to UVC light, ozone can penetrate into the dark regions of the object and make a complete disinfection. Fan circulation inside the chamber results in effective ozone transport. This is why, UVC+ozone is a more reliable disinfection process compared to UVC-only systems.
After UVC-ozone disinfection process, an ozone removal process automatically starts. It circulates the air through an ozone decomposition catalyst. With this process, the ozone concentration is rapidly reduced and reaches to a safe level before the user can open the door and take the object. The catalyst will be aged after some time and its activity is reduced. A regeneration process is provided inside the system that can be activated in order to regenerate the catalyst to its high activity state.

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