

SECTION-C

Tender no. IPR/TN/PUR/ET/21-22/003 dated 16-04-2021

Technical Specification of Quantum Efficiency Measurement System for Solar Cell

सौर सेल के लिए क्वांटम दक्षता माप प्रणाली हेतु विवरण

Here we are looking for a complete system for measurement of the quantum efficiency of thin film solar photovoltaic devices. This system includes all the optical arrangements, hardware, software etc. to cover the whole range of wavelength for measurement, user friendly operation, data collection and analysis as per the following specifications:

S. No.	Particulars	S. No.	IPR's Requirements / Specifications
1	Parameters to be measured	1.1	SR (Spectral Response)
		1.2	EQE (External Quantum Efficiency) OR IPCE (Incident Photon to Current Efficiency) in both AC and DC measurements (i.e. no chopping)
		1.3	Spectral Reflectance
		1.4	IQE (Internal Quantum Efficiency)
2	Wavelength range for measurement	2.1	350nm (or less) to 1500nm (or more)
3	Spot Size on the sample	3.1	Variable within 1mmx1mm to 3mmx3mm or more
		3.2	Shape of spot could be circular or square or rectangular as per the design of instrument.
4	Light Sources	4.1	Single or Dual (Xenon arc lamp and Quartz halogen lamp) lamp to cover whole wavelength range (as mentioned in S. No. 2).
		4.2	Each light source should have separate constant current power supply
		4.3	Proper housing for light source should be provided
5	Monochromator Configuration	5.1	Czerny Turner Configuration
6	Slit Size	6.1	Slit Height - Should be as per optics requirement
		6.2	Slit Width - variable (at least 0.15 or less to 2.5mm or more)
7	Bandwidth	7.1	5 nm or better
8	Grating	8.1	Dual or triple grating turret
		8.2	Kindly mention the blazing wavelength and lines/mm for each grating
9	Wavelength Accuracy	9.1	0.5 nm or better
10	Wavelength Scan Step size	10.1	1 nm (or less) to 10nm adjustable using software
11	Filters	11.1	Suitable combination of long pass and band pass filters to reject and allow light for high signal to noise ratio and to remove second order light peaks with multi position filter wheel should be provided.
		11.2	Selection, Switching and moving of grating, filters etc. should be auto control by software to cover entire measurement range (as mentioned in S. No. 2).
12	Optical Chopper with lock in amplifier	12.1	Optical chopper for AC measurement with control module should be provided

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		12.2	Chopper Frequency: adjustable (selectable through software) from 10Hz (or less) to 200Hz (or more).
		12.3	Arrest option for DC mode measurement (i.e. 0 Hz)
		12.4	Suitable sensor to provide frequency feedback to lock in amplifier
13	Reflectance Measurement Accessories	13.1	Integrating Sphere for total reflection (diffused + specular) measurement for whole measurement range (as mentioned in S. No. 2) should be given
		13.2	diameter of integrating sphere \geq 4 inch
		13.3	Integrating Sphere should have its separate calibrated detector for measurement in complete spectral range (as mentioned in S. No. 2)
		13.4	Facility to insure the spot size on the same location of the sample as during the EQE measurement should be provided.
		13.5	Integrating sphere should be able to accommodate the sample of 1cm x 1cm to 5cm x 5cm such that probe beam (or light spot) can be placed at any selected location of the sample. Port reducer should be provided with integrating sphere as per requirement.
		13.6	Integrating sphere should be mounted such that it can be moved in and out to adjust the same focal length of beam on sample as during the EQE measurements
		13.7	Necessary reference mirror or reflectance plate of appropriate size should be provided with integrating sphere for calibration purpose.
14	Reference Detectors	14.1	Single or Dual suitable photo detector to cover whole measurement range (as mentioned in S. No. 2).
		14.2	All the detectors should be provided with calibration certificate (by NREL, NIST, NMI or any equivalent agency).
15	Reference Cell	15.1	A calibrated certified (by NREL, NIST or any equivalent agency) solar cell (with EQE data) for QE testing and calibration purpose should be provided with the system.
16	Voltage bias capabilities for sample	16.1	Variable from -5V to +5V (selectable) for biasing the sample during the measurement should be provided with all proper connections and integration.
		16.2	Step size or resolution of 0.1V or less.
17	Sample Holder	17.1	Sample holder should be designed to accommodate and measure the rigid and flexible sample of size from 1cmx1cm (or less) to 5cmx5cm (or more) with thickness from 0.5mm to 3mm.
		17.2	Sample holder should have the magnetic base to hold the micro positioners for tip / probe connections.
		17.3	Sample holder should be designed to connect both the probes in front-front, front-back and back-back; all the three contact configuration on the sample.

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18	Micro positioners with spring loaded hemispherical tips	18.1	At least 2 nos of magnetic based micro positioners (one for positive terminal and one for negative terminal) with precise X,Y,Z movement using nobs in all three directions should be provided with proper spring loaded hemispherical gold coated probe tips and cables to insure proper electrical connections with samples without damaging / penetrating it.
		18.2	Tips / probes should be mounted properly at appropriate angle to insure the clear path for light beam. However the tilting angle should not be such that tip will slip on sample while placing or tightening.
		18.3	Length of tip holding rods and movement of X,Y micro positioner should be sufficient to cover the sample of 1cmx1cm to 5cmx5cm
19	Housing	19.1	Complete system including sample should be assembled in a dark light tight enclosure to facilitate all measurements (EQE, reflectance, IQE, SR) without the requirement of a dark room.
20	Software	20.1	System should be completely automatic with software controlled with need for minimum manual intervention for a user friendly operation for data collection, plotting and analysis.
		20.2	The software should also provide the flexibility and ease of use with full manual control over for monochromator, filters, gratings etc. for diagnostic purpose.
		20.3	Selection of Light source, grating, filters etc. should be auto control by software to cover the whole wavelength range for measurement (as mentioned in S. No. 2).
		20.4	Software should be capable of measuring, recording, storing and plotting the EQE, IQE, SR, reflectance data.
		20.5	Software should be capable of plotting multiple graphs together
		20.6	Software should be compatible with windows 10 operating system.
		20.7	Measurement range and step size of wavelength during the measurement should be user definable.
		20.8	Data stored to disc should be directly examined within the supplied software and also should be exported to a text file readable by most third party software packages like MS-excel, Origin etc.
		20.9	Licensed key of the software should be provided for lifetime.
21	Computer (Desktop Or Laptop)	21.1	A suitable computer desktop with minimum 20 inch LED monitor OR a laptop with minimum of 15 inch LED screen should be provided with instrument.
		21.2	Licensed windows 10 should be provided on PC
		21.3	Microprocessor: i5-10th generation or higher version
		21.4	Hard Disk : 500 GB or higher , RAM: 8 GB or higher
		21.5	appropriate required USB ports for connection of instrument
		21.6	USB mouse (in case of desktop)
		21.7	USB Key board (in case of desktop)

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		21.8	One spare USB port and One spare HDMI port should be available
		21.9	All necessary power and other cables and connections should be provided.
22	Power Requirement	22.1	single phase, 230V, 50 Hz,
		22.2	Mention number of required plugs and current capacity
		22.3	Extension box should be provided, if required for multiple connections
23	Scope of Vendor	23.1	Supply, Installation, Commissioning and Training at IPR site (FCIPT).
		23.2	Commissioning includes complete set including interconnections of all the system components with necessary connectors, cables, probes etc. with required automation
		23.3	Demonstration of all the measurements mentioned in S.No. 1 on IPR's solar cell (CZTS absorber based solar cell) sample with variable spot size (1x1mm ² to 3x3mm ² or 1 to 3mm dia as per instrument's design)
24	Warranty and service	24.1	Supplier should provide onsite warranty and service support.
		24.2	Minimum One year from the date of installation and commissioning at FCIPT.
25	Factory Acceptance Test	25.1	Standard reference solar cell supplied with the instrument should be tested for all four parameters (mentioned in S. No. 1) in the whole range of measurement (mentioned in S. No. 2) of the instrument and data should be sent to IPR along with standard EQE data (given by NREL, NIST or equivalent agency). EQE data of reference cell measured using the instrument should be reproducible as per certified EQE data.
26	Acceptance Criteria (Testing at IPR)	26.1	1. Standard reference solar cell supplied with the instrument (mentioned in S. No. 1) in the whole range of measurement (mentioned in S. No. 2) of the instrument and EQE data of reference cell should be reproducible as per certified EQE data (given by NREL, NIST or equivalent agency). 2. All the measurements (mentioned in S. No. 1) should also be demonstrated on IPR's solar cell (CZTS absorber based thin film solar cell). Instrument should be able to measure the data on IPR's solar cell also.
27	Mandatory Spares (for replacement) to be provided	27.1	Set of lamps used for monochromator – 1nos
		27.2	Set of reference detectors – 01nos
28	Delivery Time	28.1	15 weeks from the date of P.O.
29	Installation	29.1	2 weeks from the date of delivery

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Compliance Sheet of Quantum Efficiency Measurement System for Solar Cell

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2. Please upload/submit a compliance stated duly signed and stamped of each page while submitting your offer.

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		11.2	Selection, Switching and moving of grating, filters etc. should be auto control by software to cover entire measurement range (as mentioned in S. No. 2).	
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			lifetime.	
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Any Other information / feature etc. need to be mentioned:

**AUTHORIZED SIGNATORY
OFFICIAL SEAL & DATE**