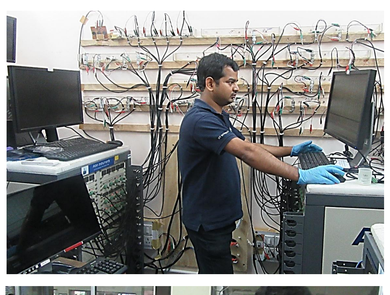
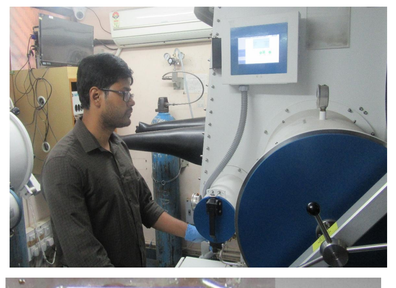
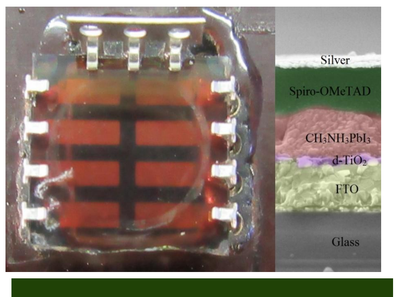
National Center for Photovoltaic Research & Education (NCPRE)

Indian Institute of Technology Bombay, Mumbai, India

www.ncpre.iitb.ac.in

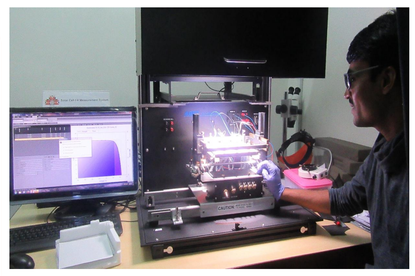


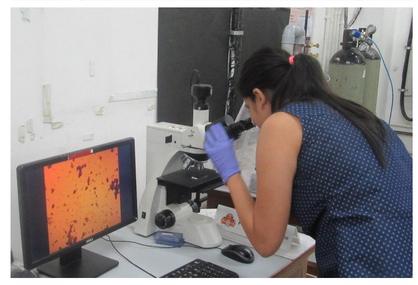


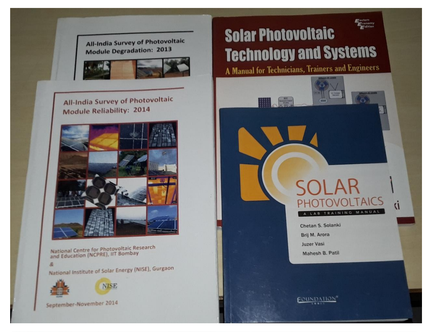


INTRODUCTION

- Setup in October 2010 by MNRE, Govt. of India as a part of Jawaharlal Nehru National Solar Mission (JNNSM)
- NCPRE mandate is to provide the strong PV research, education and training to achieve the JNNSM targets
- Funded with INR 475 million during Phase - I (2010 -2016) and INR 623.5 million for Phase - II (2016 -2021)
- Involvement of 39 faculty members from 8 departments and over 120 students and staff
- Working towards scaling up the Education & Training, Research and Device Development in thrust areas of c-Si solar cells, Thin film materials & devices, Energy storage, Power electronics & Solar module reliability
- Launched Industry Affiliate Programme (IAP) to support the mutual needs of industry and academia in PV research







Education & Training

- "Teach a 1000 Teachers" course & 32 short courses conducted
- Low cost Lab kit developed & distributed to 200 colleges
- Three Courses and training manual written in 5 Indian languages
- Author books/monographs in solar PV and related areas
- A new course on PV Technology
- Target to train 300 B.Tech., M.Tech. & PhD students
- Training entrepreneurs and handholding of startups in PV

Crystalline Si Solar Cells

- Developed industry scale 5"x5" area Si Al-BSF solar cells with η ~17.8 %
- Develop industrial process for high efficiency 6" x 6" mono c-Si using Cu front metal contact and concepts like PERC, IBC and carrier selective contact

Thin Film Materials & Devices

- Developed semiconductor-sensitized solar cells of η ~ 8.9 %
- Developed planar perovskite solar cells of η ~ 14 %
- Develop Tandem solar cell technology for Perovskites, Si or CZTS materials
- Develop new absorber layers compatible with perovskite absorbers

Energy Storage

- Demonstrated use of Li ion battery in Solar Lantern application
- Technology of industry-grade Lithium-ion battery with 0.75 Ah pouch cell
- Develop and demonstration of 2.5 Ah Li-ion battery in commercial scale
- Develop and demonstration of Na-ion battery and iron flow battery technology

Power Electronics

- Developed low-cost 500 VA solar PV systems with η > 90% for rural household
- 5 kVA transformer-less roof top grid connected system, with η > 95 %
- Low cost, high speed motor for PV based deep bore-well water pump
- A test bench for all power interface in Solar PV system under grid condition
- Develop Industry standard product for stand-alone PV system, Grid connected inverter, PV powered induction motor pump & Hybrid power management

Module Reliability

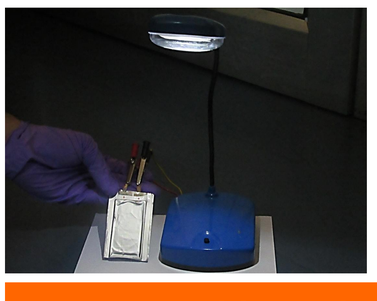
- All-India Survey of PV Modules (with NISE) covering 1080 modules at 45 sites
- Developed "Daylight Electroluminescence Technique" for field study of modules
- Field assessment of installed PV systems in different climatic zones of India
- Develop new models suitable for accelerated testing pertinent to Indian climate
- Module material quality assessment & New characterization tool development

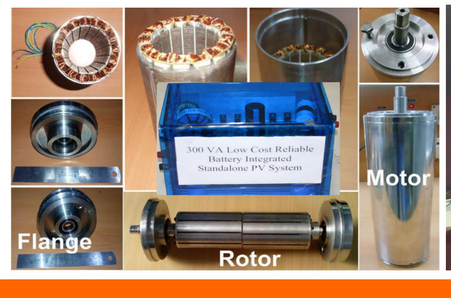
Facilities created

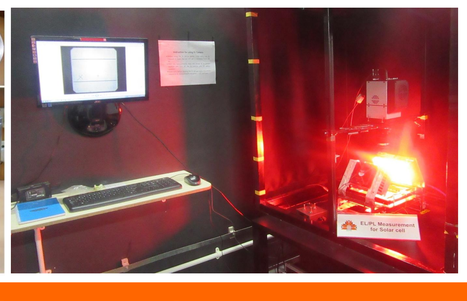
- Diffusion Furnace, Evaporator & Plasma etching tool
- Screen Printer, drying furnace and RTP
- FTIR, ALD and PECVD
- Battery fabrication Glove box and testing tool
- Autolab Potentiostat/Galvanostat PGSTAT 30
- FESEM, EVOSEM, 3D microscope
- Solar cell I-V, QE & Suns-Voc measurement set up
- Si carrier lifetime measurement with PCD and PL
- CoRRscan, adhesion tester& UV-Vis-NIR
- Laser doping tool, Centrifuge and Ball milling
- Module simulator, Environmental chamber, IR camera, EL setup, portable I-V tester
- Software's : TCAD, SPICE, ADS, Solar cell loss analysis tool

Up coming Facilities

- Belt furnace and screen printer for solar cell metallization
- Light induced & Electroplating for Ni/Cu contact
- Thermal Processer, Laser processing and ALD set up
- Glove box, cryostat, ball mill and annealing furnace for tandem cell architecture
- Screen printer, rotary and thermal evaporator for perovskite based solar cells
- Setup for organic material synthesis
- Specialized photoconductivity setup and viscometer
- Dopant Profiler and High resolution LBIC
- Lock-in Thermography & Ellisometer (for textured surface)
- InGaAs camera for EL/PL imaging of solar cells/modules
- Weather station for outdoor test
- Pyro-heliometer and multi-angle gloss meter
- UV and Environment chamber for accelerated testing
- Module Laminator and QE measurement system
- Compact spectroradiometer
- Real Time digital simulation system (RTDS) for test bench
- Solar emulators and system emulators
- Battery cell (cylindrical & pouch) fabrication facility







ACKNOWLEDGMENT

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