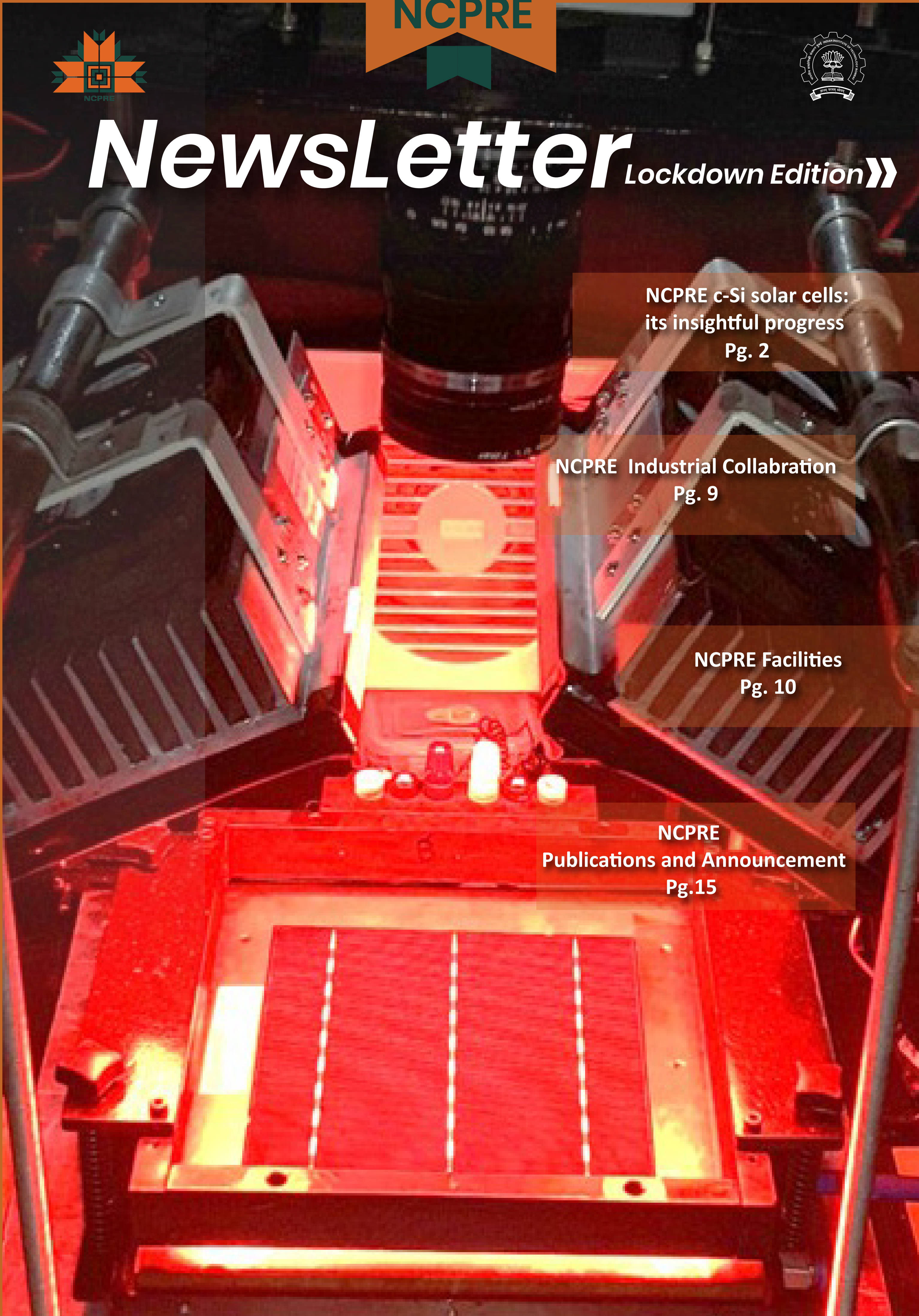
NCPRE

NewsLetter

Lockdown Edition



NCPRE *Profile*

The National Centre for Photovoltaic Research and Education (NCPRE) at IIT Bombay is one of the leading PV research center in the country. It was launched in 2010 with funding from the Ministry of New & Renewable Energy (MNRE) of the Government of India, soon after the launch of India's National Solar Mission. The broad objectives of NCPRE are to provide R&D and education support for India's ambitious 100 GW solar mission. NCPRE has 29 faculty members and over 120 research staff and students across 9 Departments at IIT Bombay. State-of-the-art laboratory facilities, with over 200 equipment spread across 12 laboratories, have been set up which are accessible to all researchers and Industries. The Centre is involved in both basic and applied research activities.

These research activities include silicon solar cell fabrication and characterization, new materials for PV devices, energy storage and batteries for PV, development of power electronic interfaces for solar PV systems, and module characterization and reliability. NCPRE has a strong programme of industry outreach. It undertakes projects and consultancy in its areas of expertise. It also provides services for characterization and measurements. NCPRE periodically conducts workshops and hands-on training in the field of photovoltaics for industry as well as academia.

"I have been involved in NCPRE and I remain excited and impressed by the R&D supporting the energy transition, particularly the development of affordable and effective electronics for, and sometimes built in, Indian villages and the ground-breaking studies of reliability and longevity of solar modules in a range of environments."

Richard Corkish,
Chief Operating Officer,
Australian Center for Advanced Photovoltaics

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NCPRE c-Si solar cells: *its insightful progress*

With the increase in the development of new technologies in photovoltaics, it is equally important to understand the vulnerabilities of such technologies, as it is expected to have a consistently good performance and ability to maintain trust among the consumers. Since eventually, the energy generated by the solar plants matters more than simply the installed capacity, it is important to pay attention to the long term reliability of PV power plants.

Novel techniques have been implemented in significant fabrication steps like texturization, emitter diffusion, emitter passivation and an anti-reflection coating, edge-isolation, screen printing and co-firing. Let's have a look at some of these techniques at a deeper level on how it is carried out.

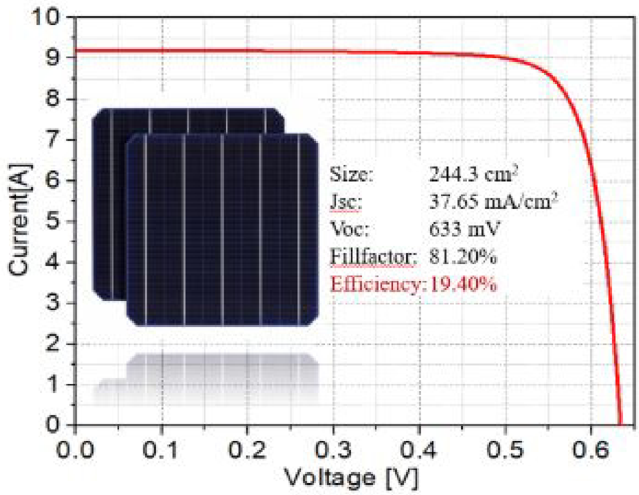


Figure: Current-Voltage (IV) characteristics of 19.4% Al-BSF fabricated in NCPRE

Innovative Texturization Method:

A novel single-step low-cost saw damage removal (SDR) solution of potassium hydroxide (KOH) has been prepared. In essence, sodium hypochlorite (NaOCl) has been introduced, followed by pyramidal texturing using KOH, potassium silicate (K_2SiO_3) and isopropyl alcohol (IPA) solution resulting in a weighted average reflectance of 13.4% for mono-crystalline wafers.

Better Diffusion and Passivation techniques:

Improved diffusion recipes using $POCl_3$, resulting in better uniformity in sheet resistance has been incorporated. Further, the sheet resistance has been increased from 65 ohm/sq. to 90 ohm/ sq. resulting in better passivation and improvement in quantum efficiency at a lower wavelength range of 300-450 nm. The emitter surface passivation quality has been improved using a low-cost, low-temperature (40°C), non-acidic and safe chemical oxide passivation process (named as NCPRE-oxide) was grown with the help of sodium hypochlorite solution. In comparison with other existing oxide growth or deposition processes such as dry thermal oxide, this process has the thermal budget, easy waste disposal, and single component nature, which makes it viable for industrial-scale implementation.

Uniform and Non-absorbing Anti-Reflection Coating:

Deposition recipes for anti-reflection coating have been optimized, resulting in non-absorbing and a uniform thickness (<5%) and refractive index (<1%). Uniformity was improved by increasing pressure, and reduction in absorption was achieved by decreasing silane-ammonia ratio.

Improved screen printing and co-firing techniques:

With the availability of new and advanced screen printers, NCPRE can now print fingers on the top side of solar cells with 45 micro-meter widths maintaining a high aspect ratio. This has resulted in the reduction of current loss due to metal shading without compromising the electrical properties. Further, a recently installed industrial-grade belt furnace has been used for co-firing of front and back metal contacts which have improved the fill factor from 80.1% to 81.2%

Prof.
Anil Kottantharayil

Dr.
Hemanta Ghosh

Patterned junctions? Just screen-print and diffuse!

The high-efficiency silicon solar cell architectures like selective emitter, bifacial, and interdigitated back contact necessitate the formation of single-sided and patterned diffused regions. We at NCPRE, study the feasibility of extending the application of screen printing, a facility which is already been used for metallization, for junction formation. The characterization results of screen-printed phosphorus dopant paste diffusion have been benchmarked against conventionally used phosphorus oxychloride based diffusion. 18.3 % efficient aluminium back surface field solar cell fabricated on 23 cm^2 area wafers, makes the screen-printed dopant paste diffusion approach promising as a cost-effective and less complicated alternative.

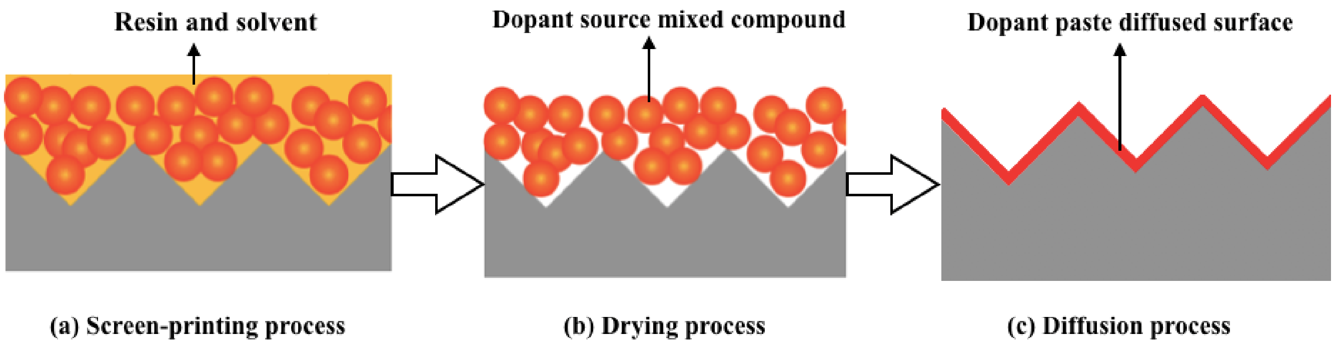


Figure: The concept of screen-printed dopant paste diffusion explained.

Black silicon technology: *the future of silicon solar cells*

The fabrication and characterization of black silicon is currently a hot topic in PV research community due to its highly desirable light-trapping properties. The research team at NCPRE has developed a low-cost, high throughput metal-assisted chemical etch process based black silicon technology, applicable for both single and multi-crystalline silicon wafers. The black silicon fabrication process consists of three cost-effective chemical processes which use silver nitrate and other PV grade chemicals. The black silicon surfaces consist of fine porous nano-textures capable of minimizing the light reflection losses especially at UV and near IR regions compared to conventionally textured single and multi-crystalline silicon wafers. An impressive overall reflectance of 3% without any ARC coating indicates the potential of black silicon technology to emerge as the next generation cost-effective texturing scheme for silicon solar cells.

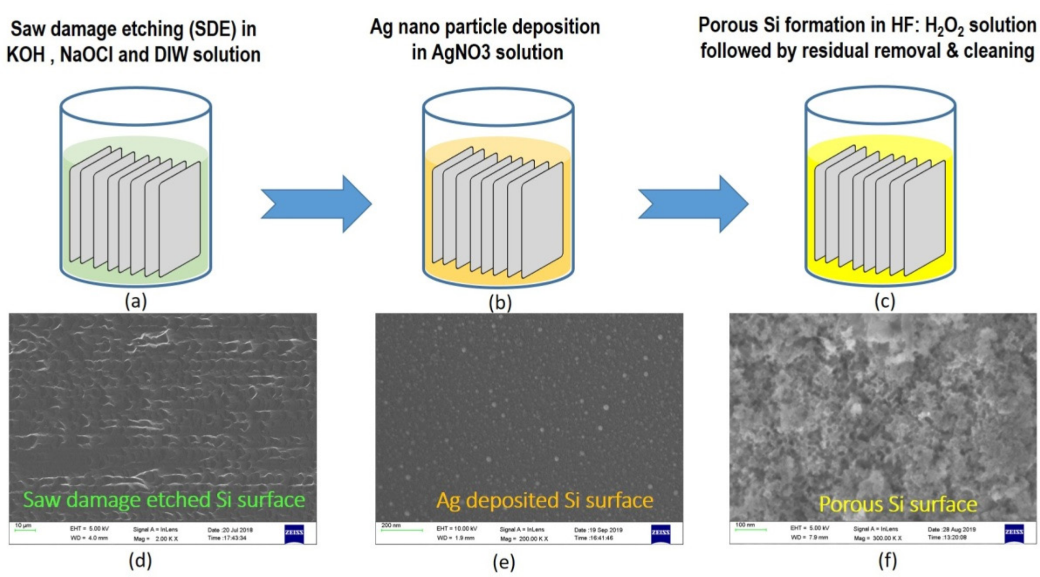


Figure: The three chemical processes for black silicon fabrication.

Sreejith KP

Saima Cherukat

Lockdown Edition

Solar cell simulator: *Optimizing design for advancement*

Do you want to optimize the screen designs for your solar cells? Provide your requirements and we shall design the screen for you, which you can use for screen printing of metal contacts, using the user-friendly solar cell simulator, GRIDDLER 2.5 PRO.

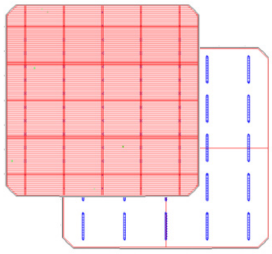


Figure: Front and Rear Contact Design

At NCPRE, new screens were designed with continuous and interrupted bus bars using GRIDDLER 2.5 PRO simulation, calibrated using real solar cells. These new designs have reduced the metal coverage by absolute 1.2%, in case of continuous bus bars and 2.5%, in case of interrupted bus bars, compared to previous designs. Using the simulator, we can also simulate solar cells by using device parameters, and by importing experimental dopant profiles, reflection and lifetime data for Al-BSF and PERC solar cells. The simulator can also be used for extracting spatial distribution of local two-diode parameters, contact resistance, grid resistance and emitter resistance of a solar cell, based on spatial data obtained from lock-in thermography, electroluminescence and photoluminescence images. These features make the simulator user-friendly and give optimized results.

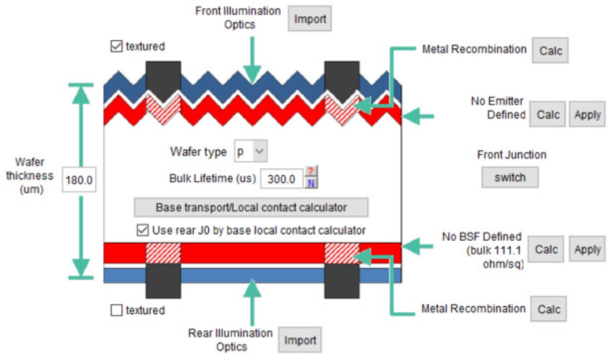


Figure: Solar Cell Device Simulation

NCPRE-Oxide Process: *Improving efficiency in a new way!*

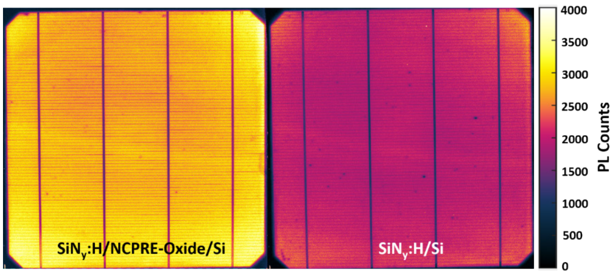


Figure: Spatial Photoluminescence (PL) Images of A1-BSF Si solar cells having SiN_y:H/SiO_x(NCPRE-Oxide)/Si stack and SiN_y:H/Si layer. Uniform and high photoluminescence (PL) count for cells with NCPRE oxide is indicative of better surface passivation and has lead to higher cell efficiency.

The evolution of Silicon (Si) solar cell technology, from aluminium-back surface field structure to A1-BSF high-performance interdigitated back contact (IBC) and Tunnel oxide passivated contact (TOPCon) structure, is possible because of advances in surface passivation techniques. A passivation layer can reduce the surface recombination losses by minimizing the surface states density by saturating the dangling bonds and by introducing a surface field.

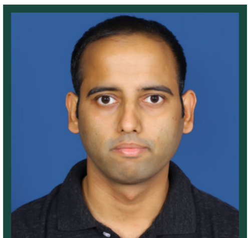
In silicon solar cells, different schemes are used to passivate the surfaces such as silicon dioxide (SiO_2), hydrogenated amorphous silicon nitride (SiN_y:H), hydrogenated amorphous silicon, high-low junctions. The thermally grown SiO_2 is an excellent surface passivation layer. However, thermal oxidation at high temperature (~1000°C) can cause severe bulk lifetime degradation, especially in multi-crystalline silicon wafers. The thermally grown oxide has limited industrial applicability due to low throughput and high cost. Silicon-Oxide (SiO) process, in contrast, is a fast (< 5 minutes), low-temperature (< 40°C) and low-cost process.

- Need a surface passivation layer

- Low throughput
- High temperature

- Fast
- Low-temperature
- Low-cost

Introduction of ultra-thin SiO_x beneath the SiN_y:H provides better passivation compared to SiN_y:H alone and improves efficiency (η) and open-circuit voltages(V_{OC}) of silicon-oxide (SiO) solar cells. The advantages of the NCPRE-Oxide process show its industrial applicability. This process can also be explored as a candidate to grow tunnel oxide in passivated contact solar cells. Details of the process have been published in several journal publications and was presented at various scientific conferences.



Tarun S. Yadav

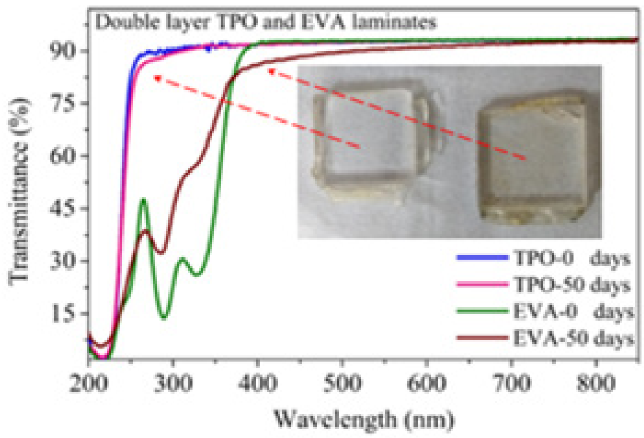
Dr. Suchismita Mitra

Lockdown Edition

Long Lasting Encapsulant

Encapsulant is an important component of solar module which provides strong adhesion between solar cells and top surface (glass) and rare surface (backsheet). Ethylene-Vinyl-Acetate (EVA) are most commonly used encapsulate.

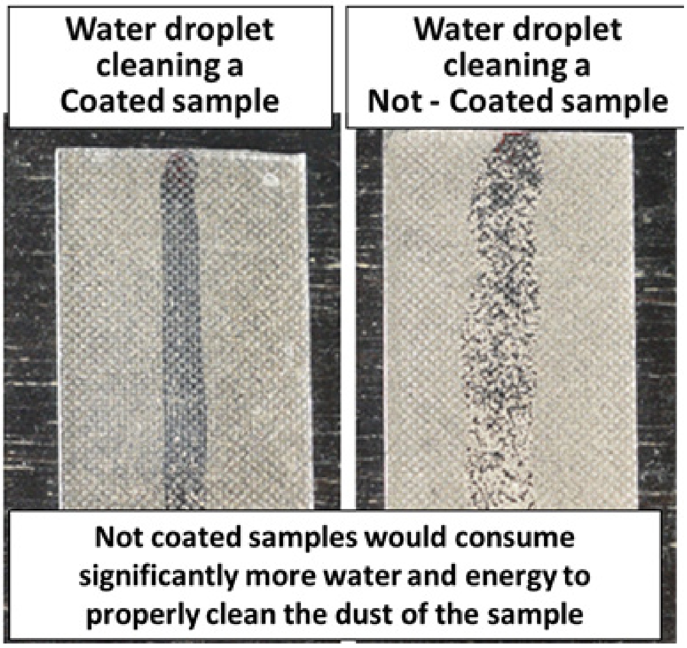
Thermoplastic Polyolefin (TPO) is a newly developed non-crosslinking material for photovoltaic (PV) module lamination as an alternative to the ethylene-vinyl-acetate (EVA) crosslinking encapsulant. We report the results of various characterization tests for discoloration and optical properties degradation conducted before and after the UV accelerated test. To evaluate its weathering stability, the UV-365 acceleration test has been conducted on the glass to glass TPO laminate, with EVA as a benchmark. In 50 days of weather ability tests, the transmittance of EVA significantly reduced while TPO remained almost unchanged. The Yellowness Index (YI) of TPO is around nine times slower than that of EVA. Fluorescence imaging of EVA shows yellow-brown colour due to the fluorophores generation. Also fluorescence emission is around nine to ten times higher for EVA when compared with TPO encapsulant.



Laminates	Transmittance (%)		ΔYI
	380 nm -700nm	220 nm - 400nm	
TOP - 0 days	92.9	85.3	0.27
TOP - 50 days	92.8	83.6	0.58
EVA - 0 days	93.0	40.7	0.32
EVA - 50 days	88.0	53.0	5.39

Raman spectra confirmed that the EVA-50 day's sample showed a strong fluorescence background due to the alpha-beta carbonyl fluorophores formation, whereas in TPO, did not show any fluorescence background. This UV weather test results confirm that TPO is a superior encapsulant than EVA. The details of publication on the different thermal stability and tensile stress-strain can be found in Page 13. From all the results, it can be concluded that TPO material can be a potential candidate for the PV module encapsulation.

What degrades Antisoiling Coating in Warm and Humid Climate Zones?



There is a high need for a cost-effective mitigation strategy to reduce energy losses due to dust deposition on PV modules. The most common practice used for cleaning PV modules today is a manual-water-based cleaning method, which also to the global water crisis. Anti-soiling coatings (ASC) is one of the most cost-effective universal solutions to mitigate dust. It is applied on the top surface of the PV module to mitigate dust deposition.

As these coatings are applied on the outer surface of the PV module, durability of these coatings become an essential factor. Among the many commercial anti-soiling coatings available in the market, we had tested 4 commercial hydrophobic anti-soiling coatings (catered to PV application) under outdoor field exposure in warm and humid climatic condition.

We saw that all coatings degraded in 3 months. We further identified the stressors which degraded anti-soiling coatings under field conditions.

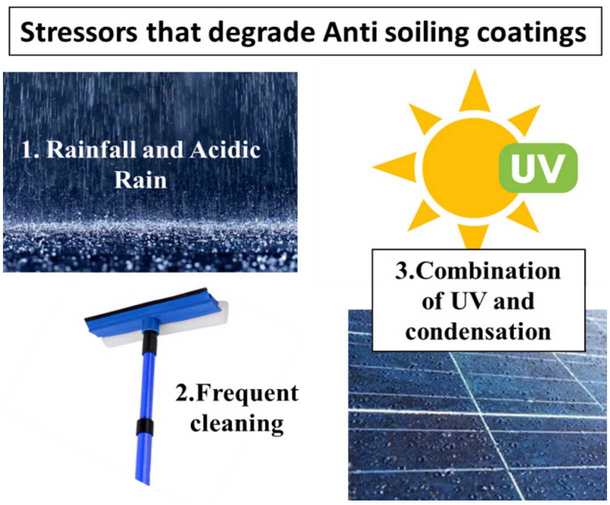
The factors that degraded the ASC are listed below :

Rainfall - Frequent cleaning (manual or natural cleaning by rain) abrades the ASC, which was identified as a statistically significant stressor in both outdoor field exposure test and indoor individual stress tests. The effect of frequent cleaning on the field was more severe, as, in the real field condition, combination of stressors acted concurrently.

Acid rain - Signatures of acid rain were seen in outdoor field test samples. The laboratory acid rain/ acid immersion test showed that hydrophobic coated samples became hydrophilic in 220 min of acid immersion.

Combination of UV exposure and condensation - We saw that the effect of the combination of UV exposure and condensation shows a higher rate of degradation than the individual stress test of only UV exposure and water immersion. This indicates that combination of stressors, also seen in field exposure, degrades the coatings at significantly higher rates than individual accelerated stress test.

Understanding the factors that degrade ASC on field, can be used in developing a standard test sequence, which will act as a baseline for the present commercial anti-soiling coating market and will also help in the development of durable anti-soiling coatings. For more detailed information, please refer to the paper - Sonali Bhaduri, Ajeesh Alath, Sudhanshu Mallick, Narendra S Shiradkar and Anil Kottantharayil, "Identification of Stressors Leading to Degradation of Antisoiling Coating in Warm and Humid Climate Zones," IEEE J. Photovoltaics, vol. 10, no. 1, pp. 166–172, 2020. DOI: 10.1109/JPHOTOV.2019.2946709




Sonali Bhaduri


Baloji Adothu

Modulation of Electronic States of Hybrid Lead Halide Perovskite Embedded in Organic Matrix

The modulation of electronic states of MAPbX3 perovskite nano-crystals (PNCs) (MA =CH3NH3+ & X = Brand I-) as a function of crystallite size in organic semiconductor matrix forming a type-I hetero-structures with the bulk perovskites. Organic semiconductor molecules [(4,4'-bis[9-dicarbazolyl]-2,2'-biphenyl (CBP) & bathocuproine (BCP)] precursors have been mixed in different volumetric ratio with MAPbX3 perovskite precursors to prepare the thin-film. This results into an easy growth of MAPbX3 PNCs of tuneable sizes from 110 nm to 10 nm in organic semiconductor matrix. We observe a blue shift in the photoluminescence peak (PLmax) energy over a range of 200 meV for MAPbI3 PNCs embedded in the BCP matrix. However, PLmax energy tunes over 32 meV only with similar volumetric concentration in case of MAPbBr3 PNCs in the same BCP matrix. Moreover, the PL blue shift is even lower in case of CBP matrix in comparison to BCP matrix for both the perovskites. This discrepancy could be resolved by determining the resultant crystallite size using x-ray diffraction studies and Debye-Scherrer formula. Results about blue shift in PL peak could be explained using the classic particle in a box vs excitonic Bohr radius model under weak confinement regime. Particularly, MAPbI3 size dependent data fits with good accuracy and provide useful insight about semiconductor material.

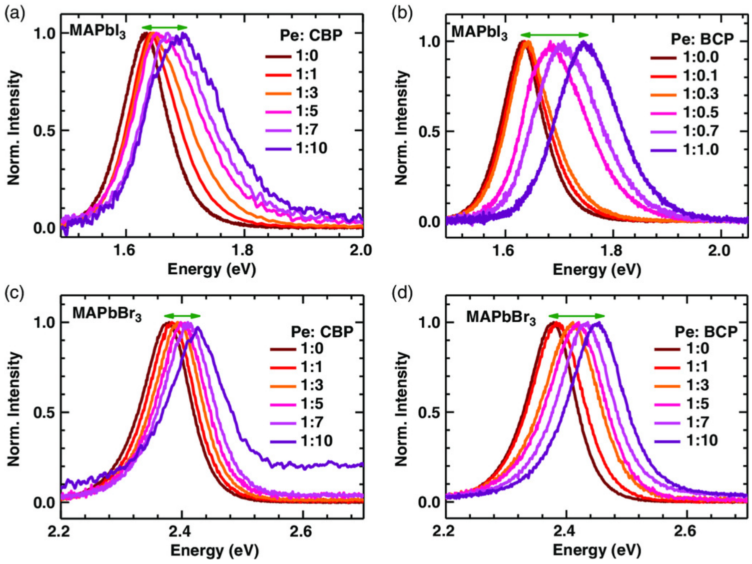
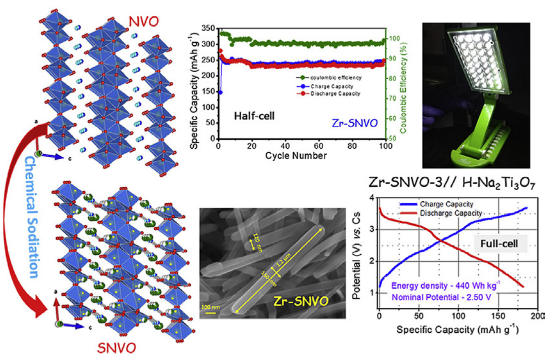


Fig: PL spectra of a) MAPbI3 :CBP, b) MAPbI3 :BCP, c) MAPbBr3 :CBP, and d) MAPbBr3 :BCP blend films with different concentrations of organic compounds.

https://onlinelibrary.wiley.com/doi/full/10.1002/ente.201900894

A new generation cathode for Sodium-ion battery



(https://www.sciencedirect.com/science/article/pii/S037877532030135x)

Sodium-ion battery technologies must have low cost, safe, and high energy density cathode with prolonging cycle life propositions for any commercial utilizations. The energy storage group at NCPRE presented, for the first time an extremely high energy density (770 Wh kg−1) and excellent electrochemical performance cathode. The cathode delivers a high discharge capacity of 255 mAh g−1 with 95% capacity retention after 100 cycles at a current rate of 200 mA g−1. Furthermore, the present report demonstrates the full-cell performance with our cathode, delivering a high energy density of 220 Wh kg−1.

The present study shows a way to produce a high-performance rechargeable sodium-ion battery full-cell using alternative cathode and anode with a comparable energy density of current lithium-ion technology. The present study gives us a direction to make such cells for future renewable energy storage systems.

Prof. Dinesh Kabra

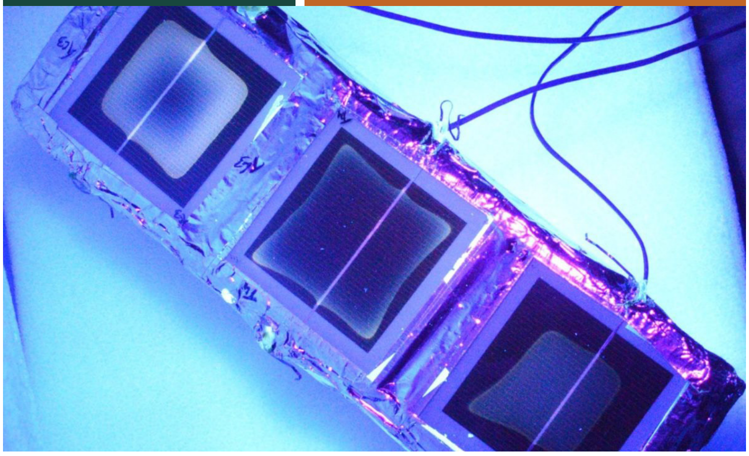
Dr. Shivam Singh

Dr. Amrita Dey

Aakash Ahuja

Identifying early-stage discoloration in EVA encapsulants

MARCH 19, 2020 | EMILIANO BELLINI



The packed mini-PV module laminate samples after testing. Image: Indian Institute of Technology

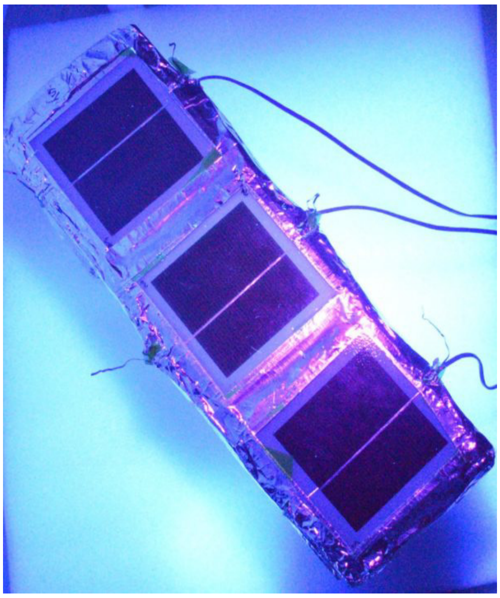
A new, non-destructive method has been proposed by researchers in India who claim identifying early-stage discoloration in EVA encapsulants can help detect degradation in solar panels before power output is affected. The scientists used an ultraviolet accelerated aging test during 34 days on three encapsulant samples.

Identifying early-stage discoloration in the ethylene-vinyl acetate (EVA) copolymer encapsulants used for crystalline solar module lamination can spot panel degradation before power output is affected.

Discoloration reduces direct short circuit current, making it a prime source of reduced panel performance, alongside premature delamination. Researchers led by academics from the Indian Institute of Technology (IIT) Bombay have proposed a new, non-destructive method of detecting early-stage photobleaching and discoloration in EVA encapsulants. Both phenomena were described as 'opposite reaction mechanisms' in encapsulants by the researchers. Discoloration, caused by the presence of conjugated compounds, volatiles and other gaseous elements, leads to the appearance of fluorophores – fluorescent chemical compounds which intercept UV light and reduce light transmittance and reflectance within PV panels. Photobleaching occurs when fluorophores are converted to non-fluorescent form and is usually localized at the edges of solar cells and does not hamper performance.

Non-destructive

To spot early-stage discoloration and photobleaching, the IIT Bombay group used fluorescence imaging, which is typically used to detect EVA encapsulant degradation, and Raman spectroscopy, a technique used to observe vibrational, rotational and other states in molecular systems. The researchers analyzed UV-cut (C), UV-transparent (T) and combined – TC – EVA encapsulant, single-cell solar module samples in a UV accelerated-aging test. The samples were placed over 12cm thick glass wool insulation and tightly packed with aluminum tape. The results showed the order in which the two opposite reaction mechanisms occurred differed depending upon the nature of the cell which underwent the accelerated aging process.



The three encapsulant samples analyzed in the study before testing. Image: Indian Institute of Technology

"It is found that the oxygen diffusion coefficient of the T sample is four and nine times slower than the TC and C samples, respectively, in the photobleached region," the scientists said. "Fluorescence imaging and spectra and Raman spectra were taken before and after the accelerated test and indicated that discoloration causing fluorophore generation was higher after [photobleaching] for transparent and combined EVAs, whereas [it was] higher at the center for UV-cut EVA laminates."

Bye Bye Induction Motors!

For years, induction motors have been in use for surface pump applications because of their simplicity and relative ruggedness. However, these motors have a "shorted" rotor structure which leads to excessive heating in long-run applications. To overcome this problem, a BLDC motor was proposed and developed at IIT-B. BLDCs have a permanent magnet rotor which means negligible rotor heating and hence lesser power loss. The developed motor has 6% higher efficiency than a similar rated induction motor. Rotation of BLDCs requires position sensors (Opto/Hall effect sensors) to sense the rotor position in order to determine which phase to excite next. However, failure of any one position sensor can cause the motor to be run incorrectly.

To overcome this, the driver developed at IIT-B, implements a sensor less algorithm which detects the rotor position by sensing the back-emf. This cost-effective solution does away the problem of potential Opto/Hall effect sensor failure on site. MPPT algorithm implemented on the controller ensures maximum power extraction from PV Panels at all times. Further work is being done to replace Si-IGBTs with GaN FETs to improve efficiency.

The tremendous reduction in size, weight and power loss would open up doors to automotive and industrial applications too.

Prof. B.G.Fernandes

Pranit Pawar

Industrial Collaboration – Success is best when it's shared

NCPRE and SINTEF Materials Technology, Norway collaborated to develop a process based Czochralski growth of low oxygen silicon single crystal for high efficiency solar cell applications. It will address the fundamental questions on how the oxygen content and related efficiency limiting crystal defects in single crystalline silicon solar cell can be reduced.

Sun Simulator facility
Accurate PV Module Power Measurement Tool

A Sun Simulator is a device which have the capability to provide the illumination approximately to natural sun light. Sun simulators are used for the measuring the power output of the PV module along with its complete IV curve and its parameters. As per IEC 60904-9 a sun simulators can be classified on the basis of a) Spectrum of light illuminated b) Uniformity over the test area c) Temporal instability. These parameter are classified as into A, B, C type. The sun simulator in NCPRE facility is of AAA type as per the IEC standard but the system have much lower spectrum mismatch, non-uniformity and, temporal instability and to identify this the manufacturer (EternalSun, Spire) have indicated by a "+" for each parameter, stating its better and accurate than standards classification. Here at NCPRE we do accept the industrial and academic request for measuring the PV modules and proving the test reports. This tool provide accurately the power with its IV curve / parameters of the modules which can be used to check the name plate value. The tool also help in testing and study of field degraded module.

Classifications	Spectral match	Non-uniformity of irradiance	Temporal instability	
			Short term instability of irradiance STI	Long term instability of irradiance LTI
A B C	0.75 – 1.25 0.6 – 1.4 0.4 – 2.0	2 % 5% 10 %	0.5 % 2 % 10 %	2 % 5 % 10 %

Specifications and Capabilities:

System Features	Specification
Classification	A+A+A+
System Type	Single Long Pulse
Lamp Type	Filtered Xenon Tube
Spectral Range	300nm – 1100nm
Range of Light Intensity	200 – 1100 Watts/m2

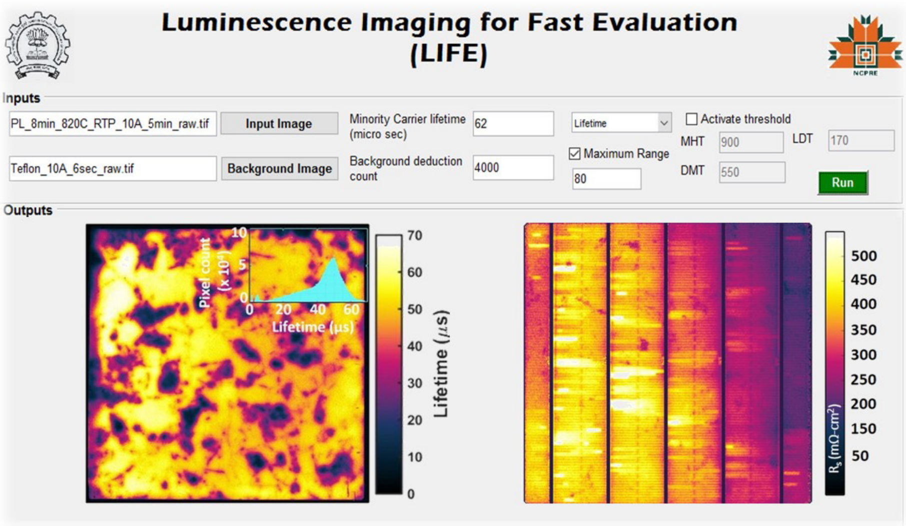
System Features	Specification
Maximum Power / Module	600 Watts
Maximum Module Size	2m (L) X 1.3m (W)
I-V Resolution	0.003%
Repeatability	<0.15%

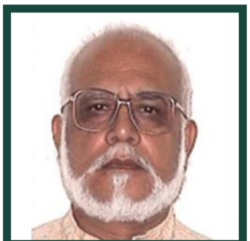
In-house developed photo- and electro- luminescence (PL/EL) imaging tool

Diagnostic for silicon wafer, solar cells, process and device development

Photoluminescence imaging of silicon using a camera produces a spatial lifetime map of photo-generated carriers in silicon. This enables tracking of changes in the carrier lifetime at different stages of processing and helps optimize the process. Researchers in NCPRE have developed a photo- and electro- luminescence (PL/EL) imaging tool shown below. The tool consists of an LED array excitation source, a probe station for contacting the cell and a camera with suitable filters to cut off the excitation wavelength. Software (LIFE) converts the luminescence intensity to a spatial map of lifetime. This tool facilitated the development of baseline process including economical texturization process, low cost emitter passivation and optimization of metallization etc. This tool has also been used to support the various PV and allied industries in India for Si wafer quality check, process troubleshooting and identification of root cause of device performance degradation.

Solar Cell Characterization Tool Developed @ NCPRE





Prof.
Brij Mohan Arora

Prof.
K. L. Narasimhan

Dr.
Ashok K Sharma

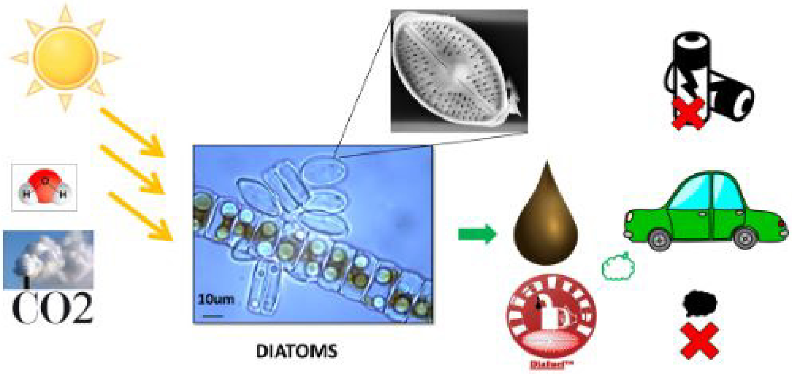
Siddharth Behera

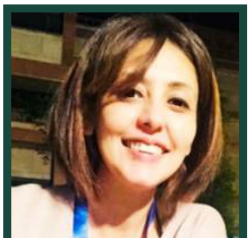
Diatoms as solar panels for DIAFUEL production

-A project carried out by Prof. Vandana Vinayak, School of Applied Sciences, Dr. Harisingh Gour Vishwavidyalaya, Sagar (M.P.) at NCPRE under PUMP

The current scenario in Middle East could be bad state of affairs for India's economy. India is world's 3rd largest consumer of crude oil which meets more than 80% of its oil requirements and 40% of its natural gas via imports. If India had its own oil reservoirs it would be easier to sustain its economy. Even though India started to switch to electric vehicles by 2030 but it has been a slow start and crude oil requirements can't be replaced at par by electricity in all. If India starts making its own oil via biofuel at large scale at low costs it could revolutionize the energy requirements not only for itself but also for other countries. Therefore India needs to focus more on its energy production via alternate measures and biofuel from algae. Among algae diatom are definitely a rescue if cost of production of biofuel from diatoms also known as diafuel is reduced.

If oil could have been milked from diatoms without killing or crushing or extracting them; just like milk is harvested from cows, the cost of production of oil could be brought down. To meet this requirement we fabricated a miniature diatom solar panel on a 2" silicon wafer as well as designed a metabolically engineered diatom in dye sensitized solar cell which produced electricity as well as diafuel. Among these it was found that our miniature diatom solar panel harvested oil with almost zero energy. The device worked effortlessly under the resonance energy gained by micro pillars in the miniature solar panel. Inspired with this work at IIT Bombay we made a bench top diatom solar panel and processed for its patent. The idea of a diatom solar panel for diafuel production is keeping diatoms in their nutrient medium exposing them to sunlight with no external source of artificial energy so as to run the system for resonance energy. This will not only encourage Indian scientist to improve alternate ways of energy source but will also make India independent of crude oil dependence onto foreign countries. The major advantages of diafuel (diatom biofuel) from diatoms are direct production of 'petrol" lipid in diatom solar panels. Diatom solar panels unlike the normal solar panels are individual diatom cell factories which harvest oil. This also explains why there would not be any need to replace automobile engines with electricity driven lithium ion batteries. Since petrol products are interchangeable, no brownouts due to electric vehicles causing electric grid shortages would occur. Also the production of the lipid energy is off the grid and petrol vehicles would remain the majority and no need for short-lived, expensive, heavy, polluting lead batteries to store solar energy may be required.





Prof.
Vandana Vinayak

Chasing dreams *Prof. Narendra Shiradkar*

I have been interested in the environment and clean energy since my high school days. After finding myself in the undergraduate program at Electrical Engineering, IIT Bombay, Solar PV seemed like an ideal area that can merge my passion towards environment and professional degree in electrical engineering. In order to persue my interest in PV futher, I decided to go to Florida Solar Energy Center (FSEC), a research institute of University of Central Florida which has been working in the area of Solar PV since 1975. During my PhD at FSEC, I primarily worked on the reliability of PV modules, investigating certain degradation mechanisms such as PID and diode failures and developing module designs that can last longer in field. Consequently, I worked for about 3 years at Jabil Circuit, St. Petersburg, Florida, leading the research activities at their PV reliability test lab anddeveloping in-line metrology and data analytics to improve the quality of PV modules made at their 1 GW/year module manufacturing facility in Europe.

In 2017, I accepted the faculty position at Electrical Engineering IIT Bombay. Ambitious PV dpeloyment plans and harsh climates pose unique challenges in the area of PV reliability for India. All India Surveys of PV Reliability conducted by NCPRE have been instrumental in understanding several field issues in India. My broad vision is to engage in activities that would ensure that we get desired about of Giga-Watt-Hours from the Giga Watts of PV deployed in India. This involves development of India-specific standards to improve the quality and reliability of PV, development of low-cost module level monitoring instruments, predictive operation & maintainance of PV plants using state of the art data analytics, root cause failure analysis & multiphysics modeling to understand new failure mechanisms etc. Several of the studies I did at FSEC, Jabil and later at IIT Bombay have shaped the international standards such as IEC 62979, IEC 63126 and I would like to continue taking up research problems that have potential to make direct impact on PV industry through a new domestic and international standards.

Prof. Narendra Shiradkar

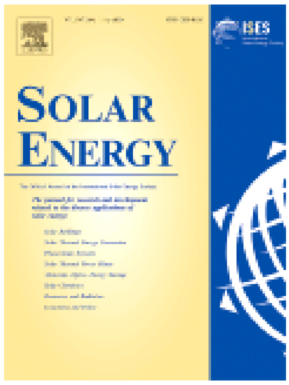
Publications

1 Adothu, Baloji, et al. **"Investigation of Newly Developed Thermoplastic Polyolefin Encapsulant Principle Properties for the c-Si PV Module Application."** Materials Chemistry and Physics, vol. 243, 2020, p. 122660., doi:10.1016/j.matchemphys.2020.122660.

2 Adothu, Baloji, et al. **"Newly Developed Thermoplastic Polyolefin Encapsulant–A Potential Candidate for Crystalline Silicon Photovoltaic Modules Encapsulation."** Solar Energy, vol. 194, 2019, pp. 581–588., doi:10.1016/j.solener.2019.11.018.

3 Sarkar, Ananta, and Sagar Mitra. **"Chemically Sodiated Ammonium Vanadium Oxide as a New Generation High-Performance Cathode."** Journal of Power Sources, vol. 452, 2020, p. 227832., doi:10.1016/j.jpowsour.2020.227832.

4 K.P.Sreejith et.al **"A low-cost additive-free acid texturing process for large area commercial diamond-wire-sawn multi-crystalline silicon solar cells"** Solar Energy Volume 205, 15th July 2020, Pages 263-274 *https://doi.org/10.1016/j.solener.2020.05.018.*



Announcements

Postponed – 5 Days workshop on Solar Off-grid Entrepreneurship Training Program (16th - 20th March 2020)

Due to the current COVID-19 situation, the Solar Off-grid Entrepreneurship training program which was due to be organized on (16th - 20th March 2020) is now postponed until further intimation. The overall program coordinated by Prof. Chetan Singh Solanki aims to cover the concepts of world energy scenario, solar PV technology, practical aspects of using solar PV modules, battery technologies, technical details of DC appliances, PV system design, hands on training on PV system installation and maintenance, PV system cost estimations, payback period calculations, aspects of running off-grid solar business, etc. The training will consist of 50% teaching in the class room wich will cover the fundamentals, technical specifications, standards, solar PV system design etc. and 50% hands on training. The certificates will be provided based upon the result outcomes of the 30 mins quiz that'll be taken every day.

Photovoltaic Users Mentorship Programme (PUMP)- Proposals Invited

In case you have a brilliant research, idea related to solar PV but do not have access to research facilities, NCPRE can help you. Under our PUMP program of NCPRE, we allow short term project (ranging from two weeks) to long term projects (up to 6 months). The purpose of Photovoltaic Users Mentorship Programme (PUMP) as a part of NCPRE Phase-II is to extend the reach of Photovoltaic by training of researchers from different institutions in India. We aim to organize these workshops, to invite topical, theme-based proposals and collaborations from researchers and faculty/students from different institutions.


Aakash Ahuja

NCPRE houses state-of-the-art Solar PV research facilities which is being used by Industry and Academia in India

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