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Analyses of Monometallic Nano Particle Coatings to Increase Solar Panel Efficiency

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Abstract:- In order to apply an antireflection coating to a PV panel and increase the solar cell efficiency by producing more voltage, current, and power at the peak power point, a thorough investigation of several chemicals and nano composite materials was carried out (MPP). An improved method of capturing solar energy and converting it into electrical energy, which would lower costs and boost power production, would be indicated by an improvement in solar cell efficiency. Antireflection, surface inactivity and the desired vitality materials band hole alter in an incredibly encouraging way when the nano composite materials are mixed with certain composition of effective chemicals to boost efficiency by coating technique. The gallium chloride nano particle solution will be made thick and applied over the solar panel using brush so that it will be applied uniformly. Monometallic nano particle coating is prepared to apply over the existing polycrystalline solar panel. Synthesis of different natural extract for monometallic nanoparticle is done. The natural extracts used are flower powder, Kailashpati fruit juice, triphala powder, neem powder and jackfruit juice. By the synthesis of these natural extracts, the monometallic nanoparticle such as gallium flower, gallium kailashpati, gallium triphala, gallium neem and gallium jackfruit are used to check its effect over the material efficiency of the existing solar panel. It is a 90% natural process using natural products such as roots, flowers, petals, fruits peels or leaves are utilized. Effect of this thin coating, applied over the existing solar panel is observed. The gallium chloride monometallic nano particle will be applied over the solar panel using spraying technique to check the effect on the solar panel efficiency. Automation in measurement of the power output of the uncoated and coated panel will be implemented. The uncoated and coated panel will be tested under the sunlight throughout the day.

Keywords: solar panel, monometallic nano particle coating, maximum power point, MMNPC, nano composites, polycrystalline and power conversion efficiency.

1. Introduction

On the one hand, energy prices have risen globally in recent years, while solar panels have become less expensive and environmental concerns have received more attention [1]. Solar energy has helped to partially meet the world's energy needs, and attempts have been made to construct solar power plants and farms [2]. The sun's light should travel through a cover glass before being turned to heat or electricity, regardless of whether a solar collector or photovoltaic panel is being used. Therefore, for the system to operate efficiently, the transmission coefficient of the cover glass is just as crucial as other elements such as panel pitch and orientation, cell temperature, maximum power point tracking and energy conversion efficiency [3]. A glass cover's gearbox coefficient steadily decreases as dust builds up on it, which reduces the output energy overall [4].

Arid areas are more suited for the installation of big solar arrays because they have stronger radiation qualities, such as great radiation power and lengthy daylight hours. The deposition of dust on surfaces, which therefore reduces the transmission coefficient and overall efficiency of the solar system [5], is one of the difficulties in employing solar systems in such places, whether they are photovoltaic panels or flat collectors. The density of dust deposition on the surface and the loss in transmittance can be influenced by a variety of factors, including installation tilt, azimuth angle, the predominant wind direction and strength, rain, and the amount of time panels and collectors are exposed to outdoor conditions without cleaning [6]. It is clear from reading the text that meteorological conditions have a considerable impact on dust accumulation. For instance, a single dust storm might result in a 20% reduction in power output from PV modules. The more sunlight that is absorbed by active photovoltaic materials will result in a higher production of electrical energy since solar cells are made to convert available light into electrical energy [7].

To maximize sunlight absorption and enhance solar cell efficiency, silicon surfaces are frequently coated with anti-reflection coatings (ARC) [8]. Texturing the silicon surface to reduce light reflection has drawn a lot of interest as a method of boosting solar cell efficiency [9]. Chemically etched porous silicon has recently been used as an ARC for high-efficiency solar cells [10]. In order to reduce the layer's macroscopic refractive index and, consequently, the reflection caused by the index mismatch at the interface, air and silicon are combined to create a porous structure [11]. This method uses a nanostructure to decrease the graded refractive index (GRIN) in order to lessen reflection.

A fixed solar panel must be positioned with it's tilted up at a precise angle in order to produce the greatest power, depending on the location's latitude [12]. The position of the sun also affects how much power a stationary solar panel produces [13]. At dawn and dusk, the majority of fixed solar panels generate 84% less power than they do at noon [14]. Therefore, if an ARC system can increase the reflection of low sunlight onto the surface of the solar cell, it will also increase the efficiency of the external solar cells [15]. This article discusses a technique for creating an efficient ARC that can keep a solar cell's efficiency. Glass samples with and without coatings had their dust surface densities and transmission coefficient losses evaluated and compared. First, a few different coatings will be briefly discussed in the following sections. After a description of the climate in the test location, the fundamentals of the experiment and the findings will be discussed.

2. Recent Research Works: An Overview

Aisha Koprulu et al. [16] studied the performance of standard photovoltaic panels, concentrated photovoltaic (CPV) systems, and water-cooled CPV systems in relation to the impact of the environment (dust and high temperatures) on the output of the solar cell (efficiency - maximum energy and output). In the real world, solar panels with comparable specs were employed. One of the panels is clean, while the other is covered with the same storm-brought dust that was gathered off the building's roof. From the hours of 9:00 am through 5:00 pm in July and August, four incidents of dust weights were investigated (later employing dust layers and dealing with thickness). According to the findings, the temperature of the cell rose in direct proportion to the thickness of the dust layer that had been formed, which reduced the cell's power and output current in comparison to a clean cell. The energy was reduced by 60% when the dust layer was at level 4 (dust), and under the same conditions, the output current lost about 0.6 amps.

According to Reham Kamal et al. [17], who assert that the dust accumulation had an effect on the PV module, the current-voltage and power-voltage characteristics of a PV module are being assessed by theory and experiment. A technique for following incident solar radiation through a module's layers was described in computer code in order to ascertain how the radiation is reduced before it reaches the module. This approach considered how radiation at the interfaces between the layers reflected and transmitted. The radiation absorption by the dust layer and glass cover is also considered. For the measurement of reflectance and transmittance, X-ray fluorescence equipment must be used to analyze the collected dust to ascertain its composition. Individual dust component refractive and absorption indices and their associated effective values for the overall sample are assessed.

The research of Fatima Lach-Heb et al. [18] on the impact of partial shade on the performance of various types of PV solar panels has been published. White leaf, tree leaf, and transparent paper were the three types of covering materials used in the studies, together with a mono-crystalline panel and a polycrystalline panel. The electrical characteristics of the modules were evaluated in each case, and the percentage of darkened cells changed by 20, 50, and 100%. Each of the materials utilized had a distinct transmittance level.

Perovskite solar cells (PSCs) are becoming more prevalent as a result of the recent fast advancements, according to Tarek I. Alanazi [19]. PSCs have an excellent photovoltaic performance that is now greater than 25% for single-junction solar cells; as a result, they have a strong potential for industrial production and commercialization. Yet, the device area of a PSC is the biggest problem that commercial applications encounter. Large-area PSCs may be produced using a variety of fabrication processes, including vacuum deposition, slot-die coating, spray coating, and blade coating. In this work, the spray coating technique for PSC development is reviewed. The recent advancements in spray-cast PSCs are outlined, with an emphasis on the deposition technique, performance, morphology, stability, and large-area fabrication. The study comes to the conclusion that spray coating is the best technique for scalable production of large-area PSCs with moderate to high efficiency.

A study of the coatings' residual colour was made possible by Yunfei Xu et al. [20] innovation by comparing double-layer antireflection (DLAR) coatings with standard SLAR and DLAR coatings under both normal and oblique incidences. We created the mesoporous DLAR coatings in accordance with the plan, and they displayed a high average transmittance of Tave = 99.02% at visible wavelengths between 380 and 780 nm and a low chroma value of C = 3.35. The average relative improvement in power conversion efficiency for the crystalline silicon mini-modules employing the mesoporous DLAR coatings was 2.40%. Durable DLAR coatings with a neutral colour are essential for giving photovoltaic modules a natural, sheer-black appearance free of an unwanted blueish tint and for usage in consumer electronics, building glazing and display windows in addition to increasing power production.

3. The Proposed Antireflection Coating in Solar PV Cell

To get the most power out of the PV panel, numerous scholars have written about modeling PV and creating MPPT algorithms [21]. The following equations can be used to determine the following theoretically.

First, I_{PV}^{cell} should be determined as in Eq. (1).

$$I_{PV}^{cell} = \frac{P_{AP}\left[A_R I_{SCR} + T_{SCI}\left(T_{AP} - T_{REF}\right)\right]}{P_{REF}}$$

(1)

Here, solar irradiation is mentioned as P_{AP}, and the anti-reflection coating reflective constant is indicated as A_R having a value of 1.25. The short circuit current of a PV module is I_{SCR}, the short circuit temperature coefficient T_{SCI} in A/K, and the reference solar irradiance in w/m^2 are all indicated as P_{REF}. The applied temperature T_{AP} for the PV module is 25°C, T_{REF} is the Reference temperature in Kelvin.

Based on Eq. (2), the reverse saturation current of the diode I_o^{cell} should be estimated in Amps.

$$I_o^{cell} = \frac{A_R I_{SCR}}{e^{V_{oc}/V_{TH}}}$$

(2)

Here, the open circuit voltage is denoted as V_{oc} and V_{TH} is the theoretical voltage. Substituting equations (1) and (2) in equation (3), which gives V_{mpp},

$$V_{mpp} = \frac{N_T K N A_R T_{AP}}{Q} \ln\left[\frac{I_{PV}^{cell} - I_o^{cell}}{I_o^{cell}}\right] \tag{3}$$

Here, N_T is used to denote the total number of PV cells, T_{AP} is used to define the junction temperature in Kelvin (K), N is the ideality factor of a diode, Q is used to represent the electron charge $(1.602\times10^{-19}c)$ and K is used to represent the Boltzman's constant (1.381×10^{-23}) in J/K.

To attain the maximum power point current (I_{mpp}), substitute Equation (3) for Equation (4),

$$I_{mpp} = A_R I_{SCR}\left[1 - e^{\frac{(V_M - V_{OC})}{V_{TH}}}\right] \tag{4}$$

Here, the Maximum power point voltage is denoted as V_M. The power at MPP can be achieved by the Eq. (5).

$$P_{MPP} = V_M \times I_{mpp} \tag{5}$$

Calculations show that the reality values of nano particle coating power are finally catching up to the theoretical values. The solar irradiance and the coating's reflectivity for reflection are also much better than those described in prior literature and have superior values for the maximum power calculations.

3.1. Monometallic nano particle coating (MMNPC)

The primary factor that affects a PV cell's efficiency is the silicon solar cell's ability to reflect light when it strikes the panel. The property of light reflection coefficient may be decreased by covering the PV surface with a composite coating layer. The PV cells that are utilized to produce power in the modern world are made of silicon, either monosilicon or polysilicon. In order to create silicon cells, the material is cut into minuscule layers using a metal wire. These silicon film layers are utilized as a substrate. For cathodes, silicon is manufactured to be thinly p-doped [22]. A silicon cell's top surface is frequently just lightly doped with n-dope, providing conductive material for anodes. By framing a P/N junction along these lines, it is possible to separate the charge transporter sets caused by daylight ingestion. The front surface of the panel should have a thin monometallic nano particle coating to minimize the silicon's reflective characteristic [23]. Printing, vapour deposition, and other methods can be used to apply this coating and provide superior performance.

3.2. Nano-based materials and composites

Micro materials used to provide superior results in the past, but owing to the rapid advancement in technology, the employment of nano particles has greatly enhanced the advantages of effectively harnessing solar energy. MMNPC will undoubtedly lower overall costs while improving the efficiency of the solar system. The materials' properties in this case will enhance the PV cell's optical properties and get rid of any dust or water droplet encrustations on the cell's surface [24]. The spraying method is the one to use while applying the coating.

3.3. Solutions and nano materials used for antireflection coating

Preparation of gallium chloride solution: W (0.352)g Gacl3 salt i.e (2Mm). Take a clean beaker whose volume is 1000 ml. In the volumetric flask take 1000ml deionized water. To this then add gallium salt, shake the solution and then sonicate it for 10 min without temperature. The Gallium Chloride Solution is presented in figure 1.

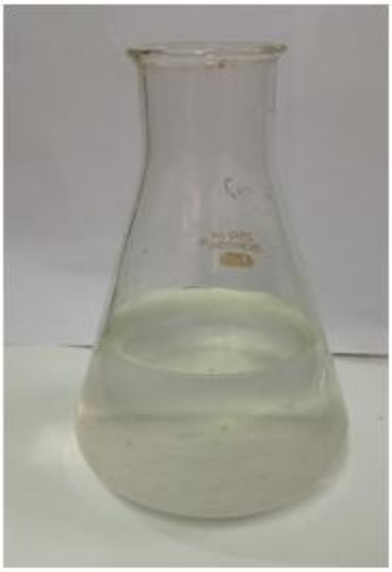


Figure 1. Gallium Chloride Solution

3.4. Detailed methodical approach to prepare the MMNPC

3.4.1. Gallium Flower powder coating

Gallium chloride (2 Mm) metal salt was dissolved in 1000 ml deionized water. Take 10 flasks and add 100 ml mixture of gallium chloride and deionized water to each flask. Add 4 ml flower extract into each flask and then sonicate the solution for 60 minutes to maintain its PH. After 24 hours these nanoparticles are settled down and the color is changed. This nanoparticle is further centrifuged at 3000 RPM and then separated. This separated nanoparticle is dried at room temperature at 40 to 50°C and the powder is used for the characterization. Gallium Flower powder Coating solution is illustrated in figure 2.

Procedure: The following flower's dry floral powder is combined with 70 ml of deionized water in a beaker. Following that, this mixture is boiled for 20 minutes at 80 to 90°C. The combined solution is filtered using Whatman no. 1 filter paper after cooling. For further nanomaterial synthesis, this clear filtrate is employed.

Figure 2. Gallium Flower powder Coating solution

3.4.2. Gallium Jackfruit:

Gallium chloride (2Mm) metal salt was dissolved in 1000 ml deionized water. Take 10 flasks and add 100 ml mixture of gallium chloride and deionized water to each flask. Add 4 ml jackfruit juice extract into each flask and then sonicate the solution for 60 minutes to maintain its PH. After 24 hours these nanoparticles are settled down and the color is changed. This nanoparticle is further centrifuged at 3000 RPM and then separated. This separated nanoparticle is dried at room temperature at 40 to 50°C and the powder is used for the characterization. The Gallium Jackfruit Coating solution is presented in figure 3.

Procedure: Take1 fresh baby Jackfruit, wash it properly and then cut it into small pieces. Further make a fine paste of it and mix it with 200 ml water. The mixture is then boiled at 70-80°C for 20 minutes. Following cooling, the solution is then filtered through Whatman No. 1 filter paper. This transparent filtrate is employed in subsequent processes.

Figure 3. Gallium Jackfruit Coating Solution

3.4.3. Gallium Kailashpati fruit juice coating:

Gallium chloride (2 Mm) metal salt was dissolved in 1000 ml deionized water. Take 10 flasks and add 100 ml mixture of gallium chloride and deionized water to each flask. Add 4 ml Kailashpati fruit extract into each flask and then sonicate the solution for 60 minutes to maintain its PH. After 24 hours these nanoparticles are settled down and the color is changed. This nanoparticle is further centrifuged at 3000 RPM and then separated. This separated nanoparticle is dried at room temperature at 40 to 50°C and the powder is used for the characterization. Gallium Kailashpati Fruit juice Coating solution is presented in figure 4.

Procedure: One fresh fruit is washed and dried properly. Later it is cut into small pieces to make fine paste. This fine paste i.e., the fruit juice is mixed in 500 ml deionized water. After boiling for 20 minutes at 70 to 80°C, the mixture is chilled. Whatman No. 1 filter paper is then used to filter the solution. The prepared clear filtrate is further used for synthesis.

Figure 4. Gallium Kailashpati Fruit juice Coating Solution

3.4.4. Gallium Triphala Coating:

Gallium chloride (2 Mm) metal salt was dissolved in 1000 ml deionized water. Take 10 flasks and add 100 ml mixture of gallium chloride and deionized water to each flask. Add 3 ml Triphala fruit extract into each flask and then sonicate the solution for 60 minutes to maintain its PH. After 24 hours these nanoparticles are settled down and the color is changed. This nanoparticle is further centrifuged at 3000 RPM and then separated. This separated nanoparticle is dried at room temperature at 40 to 50°C and the powder is used for the characterization. Gallium Triphala coating solution is presented in figure 5.

Procedure: Triphala fruit that was still dry and fresh was coarsely chopped, washed with distilled water, and dried to form fine powder. The powder was added to 70 ml deionized water and boiled for 20 minutes. The mixture was cooled and then filtered to obtain clear aqueous extract of definite concentration for synthesis of nanoparticle.

Figure 5. Gallium Triphala coating Solution

3.4.5. Gallium Neem coating:

Gallium chloride (2 Mm) metal salt was dissolved in 1000 ml deionized water. Take 10 flasks and add 100 ml mixture of gallium chloride and deionized water to each flask. Add 4 ml neem extract into each flask and then sonicate the solution for 60 minutes to maintain its PH. After 24 hours these nanoparticles are settled down and the color is changed. This nanoparticle is further centrifuged at 3000 RPM and then separated. This separated nanoparticle is dried at room temperature at 40 to 50°C and the powder is used for the characterization. Gallium Neem Coating solution is presented in figure 6.

Procedure: Dried neem leaves are crushed into the grinder to make fine powder. This powder is mixed into 70 ml deionized water in beaker and further boiled at 70-90° C for 20 minutes. After cooling, the mixture is filtered and used for further process.

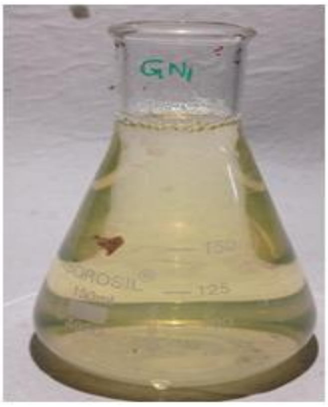


Figure 6. Gallium Neem Coating Solution

3.5. Coating Methodology

The steps for doing MMNPC on a PV cell are listed below:

Process1: Buy a polycrystalline PV panel made of commercially available materials, then thoroughly clean it with ethanol to ensure that all accumulated dirt is eliminated and the panel is clean [25].

Process 2: To make a solid adhesive basis for additional coating, take a tiny composition of gallium chloride, carry out the experiment described above, and apply the main coating to solar cells.

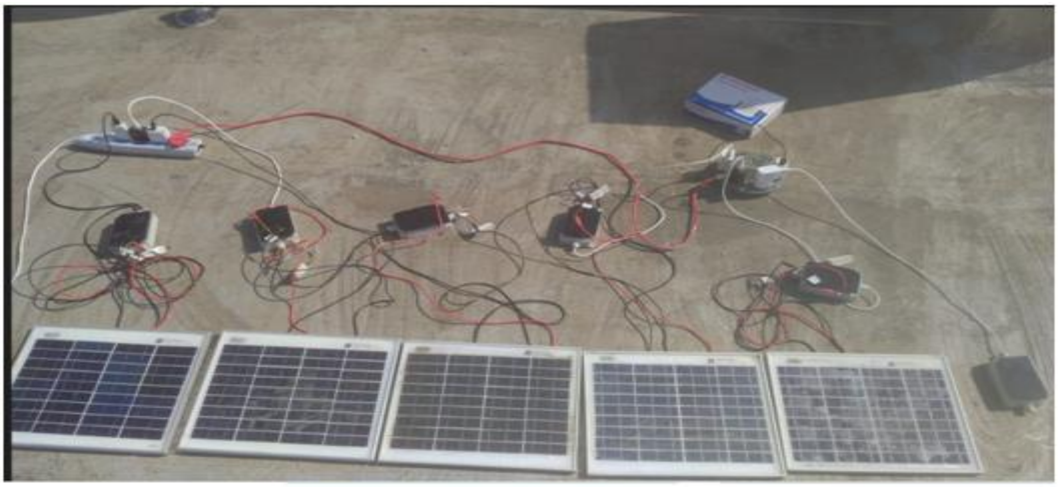
Process 3: Spraying should be used to coat the panel in order to preserve consistency, which boosts productivity.

Process 4: In order to more effectively accomplish the optical qualities that the MMNPC gains on the panel surface, the coated panel should be maintained at a consistent temperature of around 3,000 K before being evenly returned to normal temperature conditions after drying.

4. Experimental Result and Analysis

Both coated and bare surfaces exhibit molecular structural organization. The original surface finishing of Si will still be present on the untreated surface, however on the coated surface, a thin coating layer that can reduce reflection will be seen. As compared to the current literature, there will be a significant increase in efficiency if the MMNPC is used. Mono metallic nano particle coating that is gallium chloride solution is sprayed over the existing polycrystalline solar panel. The testing of the uncoated and coated panel is done directly under the sunlight. The figure of the setup is shown figure 7.

(a)



(b)

Figure 7. Setup to test the coated and uncoated panel

4.1. Hardware Setup

The pin diagram for the module utilized in this instance, the INA226 Voltage and Current Monitoring Sensor Module, is shown in figure 8. A current shunt and power monitor with an interface compatible with I2C or SMBUS is the INA226. Both the bus power supply voltage and the parallel voltage drop are concurrently monitored by the gadget. The internal multiplier is utilized in conjunction with the programmable calibration value, conversion time, and average value to directly read the current in amperes and the power in watts. The I2C compliant interfaces of the device provide up to 16 programmable addresses.

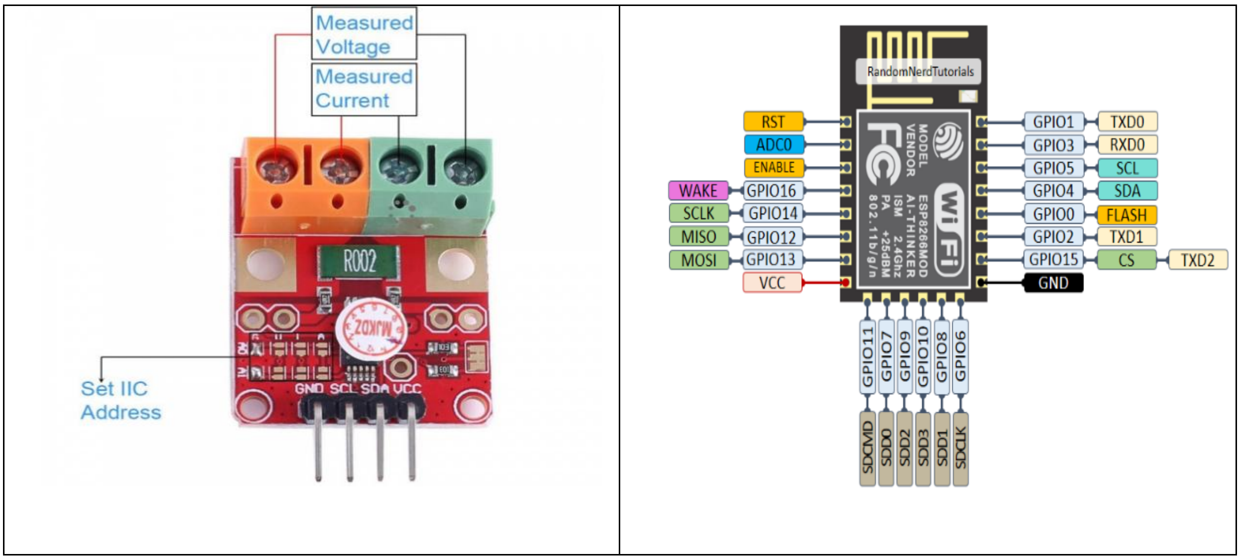


Figure 8. INA226 module and pin diagram

Table 1. Rated Specifications

Variant	Input Voltage	Supply Voltage
INA226	0-36V	2.7-5.5V DC
INA219	0-26V	3.0-5.5V DC

In table 1 presented rated specifications. The ESP8266 wireless transceiver, created by Espressif Systems, is a low-cost, simple-to-use, small-size, and low-power WiFi module that supports both TCP/IP and Serial Protocol. Because of its inexpensive price and compact size, it is typically utilized in embedded IOT applications that leverage the cloud. It is regarded as the most extensively used WiFi module. If you are utilizing a 5V supply, you need to use an external logic level converter since it operates at a maximum voltage of around 3.6 V and runs at 3V.

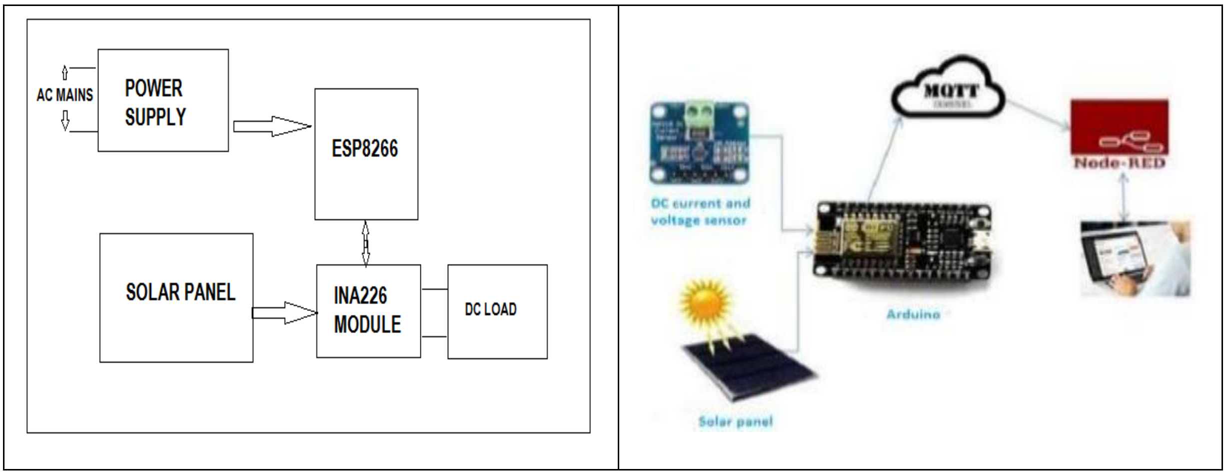


Figure 9. System Block Diagram and Design Diagram

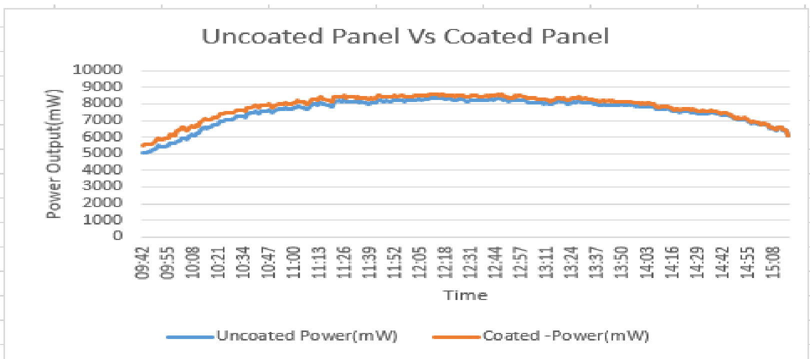
Five devices were designed to measure the voltage and current across the load connected with the solar panels, the system block diagram and design diagram is illustrated in figure 9. In one device the lux meter is mounted to measure the sun intensity. One panel is kept uncoated and others are coated with the anti-reflecting coating. The parameters measured for uncoated and coated panels are Voltage, current, power output, temperature of the panel.

4.1. Synthesis of monometallic nano particle

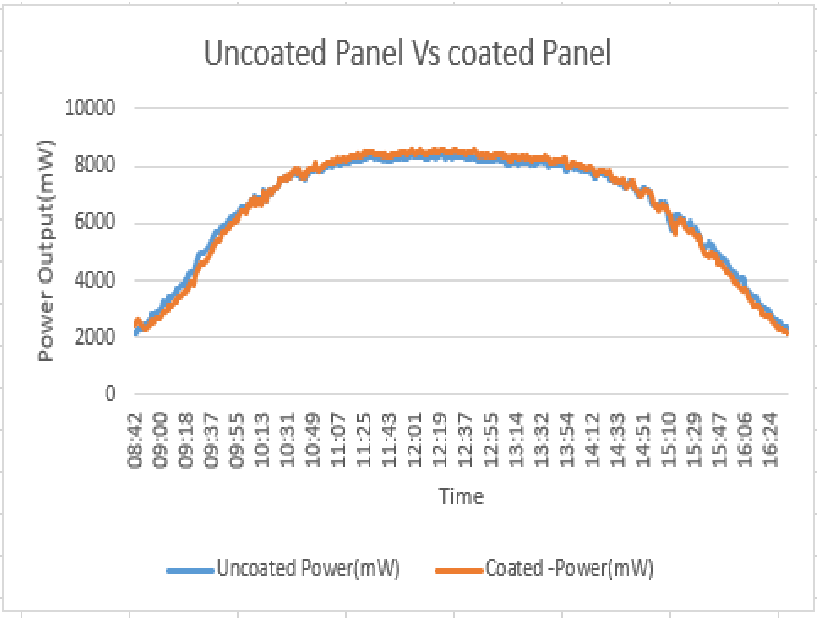
In order to evaluate the hopeful performance of reaching the best output of power at MPP, the results of the nano composites with MMNPC are carefully compared with uncoated polycrystalline panel. It is clear that the coated MMNPC coated PV Panel provided innovative results relative to the standard cell, since the power efficiency is better. With its high refractive index and significantly reduced reflectivity effective coefficient, PV panels significantly enhance optical characteristics, raising the antireflection coating reflective constant to 25%. Due to their optical characteristics, nano particles are the materials employed to demonstrate an outstanding improvement. Chemicals are often included in the MMNPC layer, and these chemicals will minimize any panel faults. The grain boundaries on the coated surface will be stronger and more visible. Performance's potency was made clear to me in the experiment indicated above that employed the hydro spraying strategy. The combination of monometallic nano particles results in the exceptional MMNPC characteristics, which enable thin coatings and high refractive indices. The MMNPC's thickness is essential for developing its electrical characteristics, and as it rises, performance naturally declines as the optical qualities are constrained. The ISCR and power have increased significantly as a result of these characteristics. This MMNPC technique is primarily intended to reduce the Si's reflection property and boost efficiency.

4.1.1. Analysis of Gallium Flower (GF) Coating

The graphical representation of the uncoated and Gallium Flower coated panel output power in different days is shown in Figure 10.



(a)



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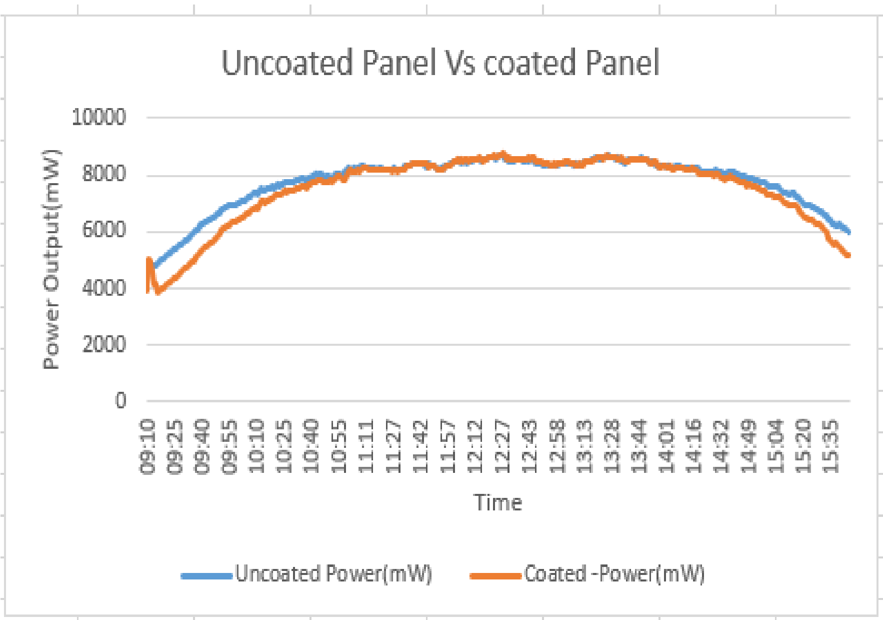
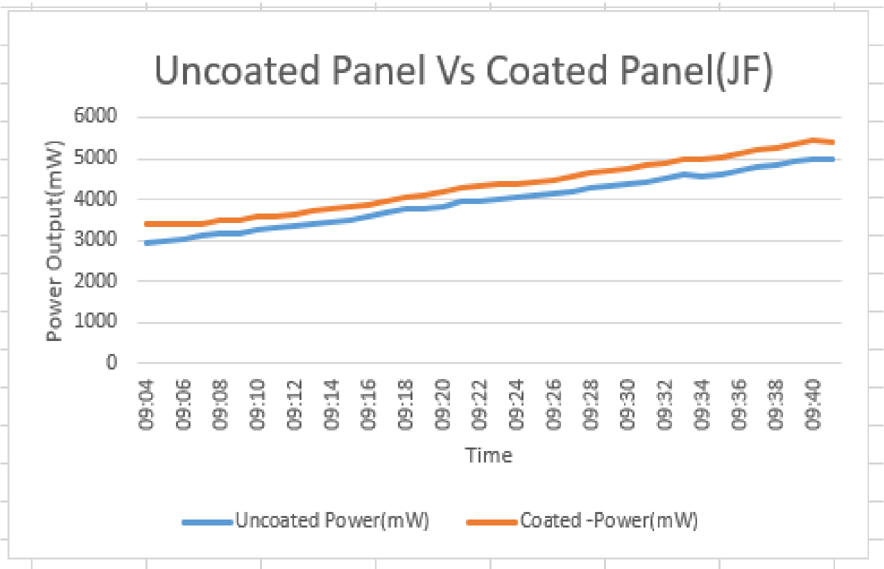


(c)

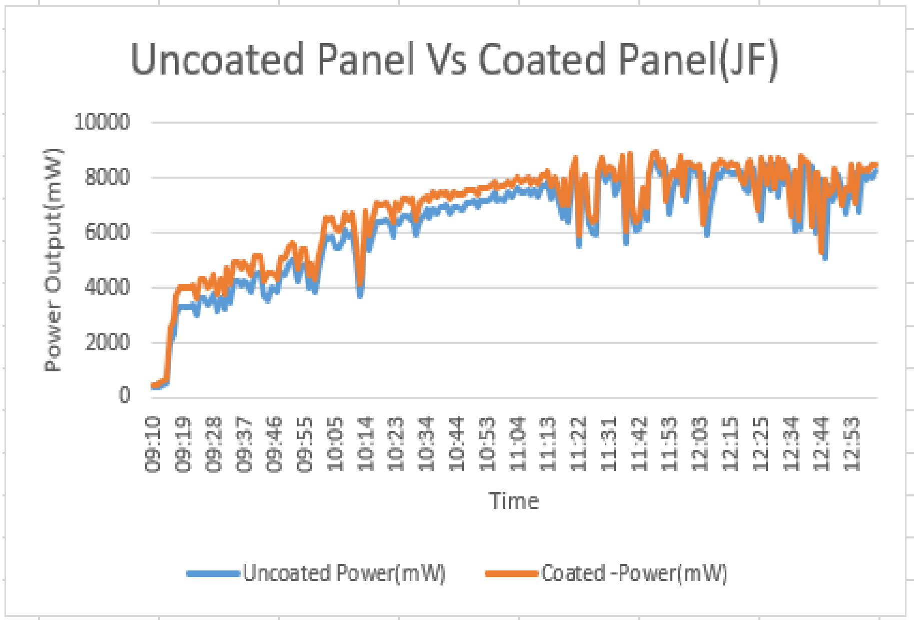
Figure 10. The time Vs uncoated and Gallium Flower coated panel power output in (a) Day1, (b) Day2 and (c) Day3

4.1.2. Analysis of Gallium Jackfruit (JF) Coating

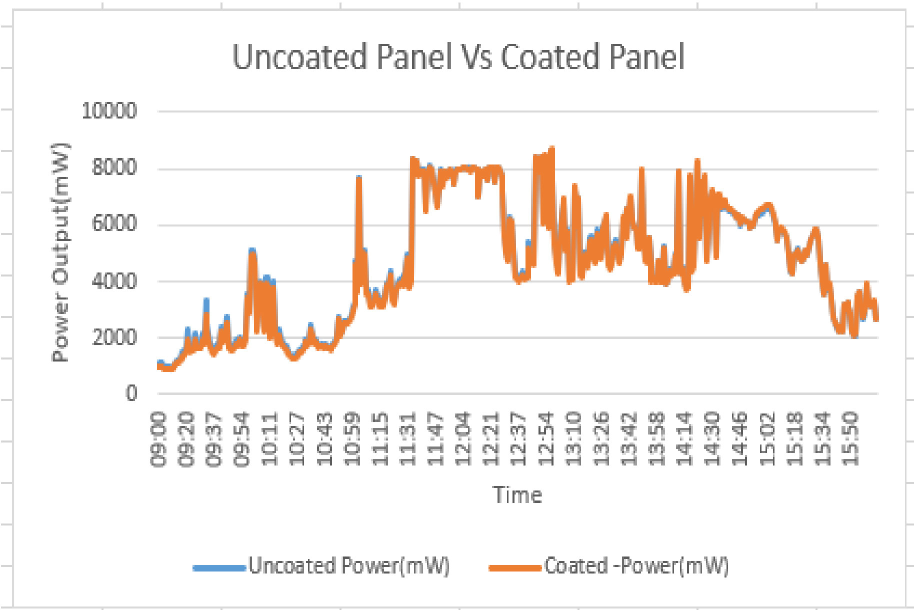
The graphical representation of the uncoated and Gallium Jackfruit coated panel output power in different days is shown in Figure 11.


Uncoated Panel Vs Coated Panel(JF)
6000
5000
4000
3000
2000
1000
0
Power Output(mW)
09:04
09:06
09:08
09:10
09:12
09:14
09:16
09:18
09:20
09:22
09:24
09:26
09:28
09:30
09:32
09:34
09:36
09:38
09:40
Time
Uncoated Power(mW)
Coated -Power(mW)

(a)


Uncoated Panel Vs Coated Panel(JF)
10000
8000
6000
4000
2000
0
Power Output(mW)
09:10
09:19
09:28
09:37
09:46
09:55
10:05
10:14
10:23
10:34
10:44
10:53
11:04
11:13
11:22
11:31
11:42
11:53
12:03
12:15
12:25
12:34
12:44
12:53
Time
Uncoated Power(mW)
Coated -Power(mW)

(b)

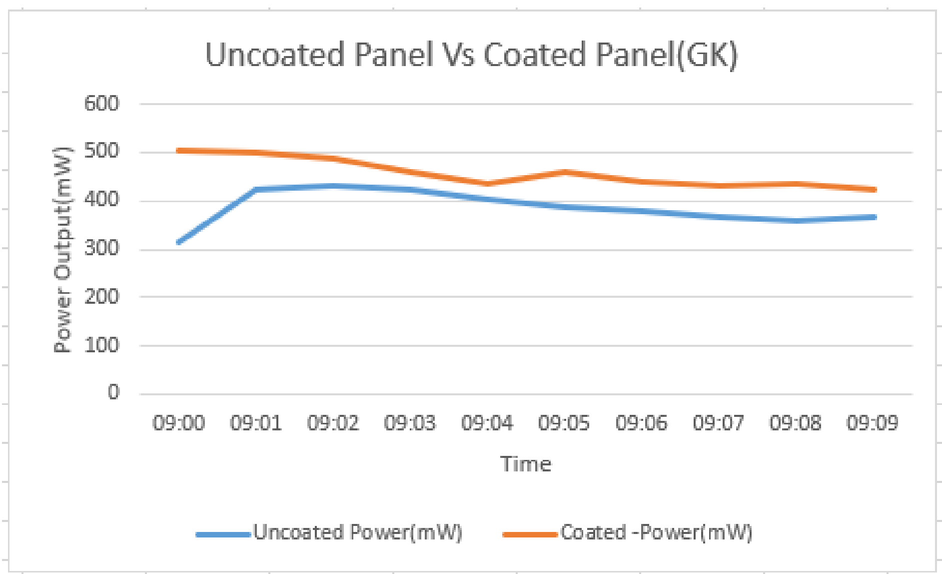


(c)

Figure 11. The time Vs uncoated and Gallium Jackfruit coated panel power output in (a) Day1, (b) Day2 and (c) Day3

4.1.3. Performance of Gallium Kailashpati (GK) Coating

The graphical representation of the uncoated and Gallium Kailashpati coated panel output power in different days is shown in Figure 12 and 13.



(a)

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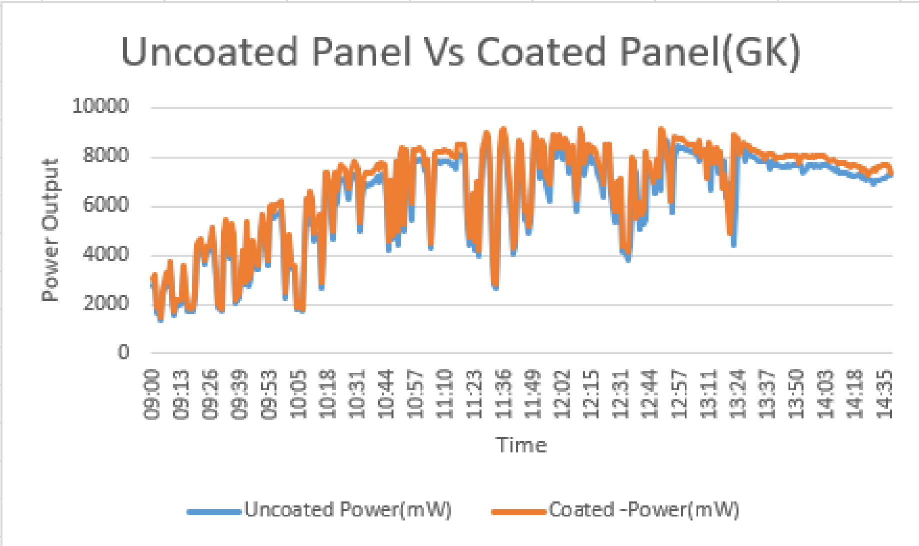

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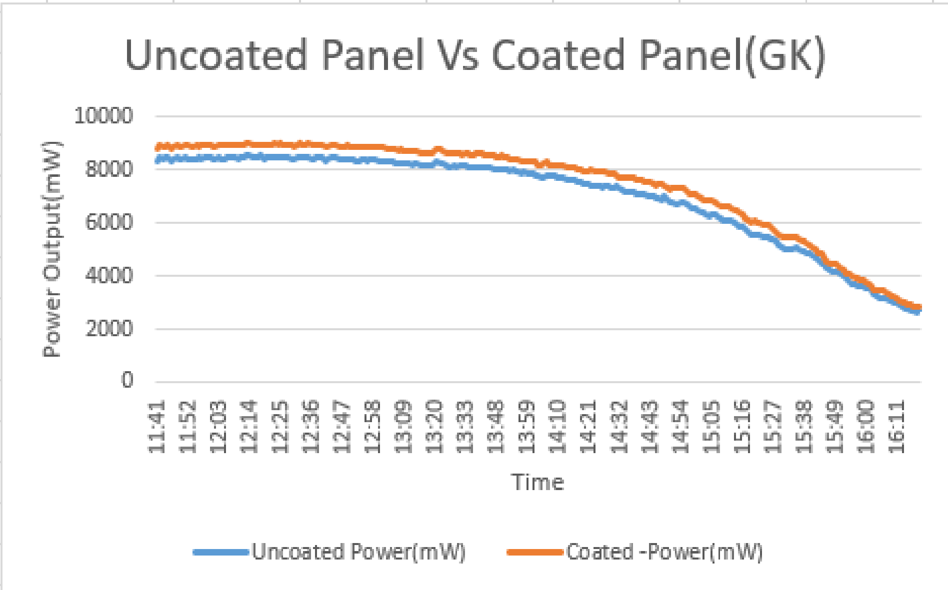

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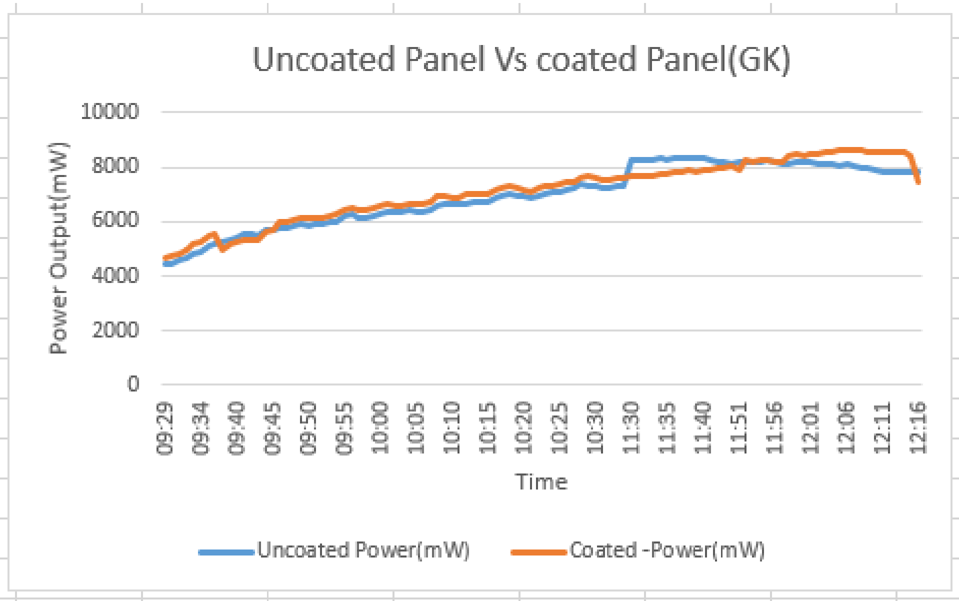
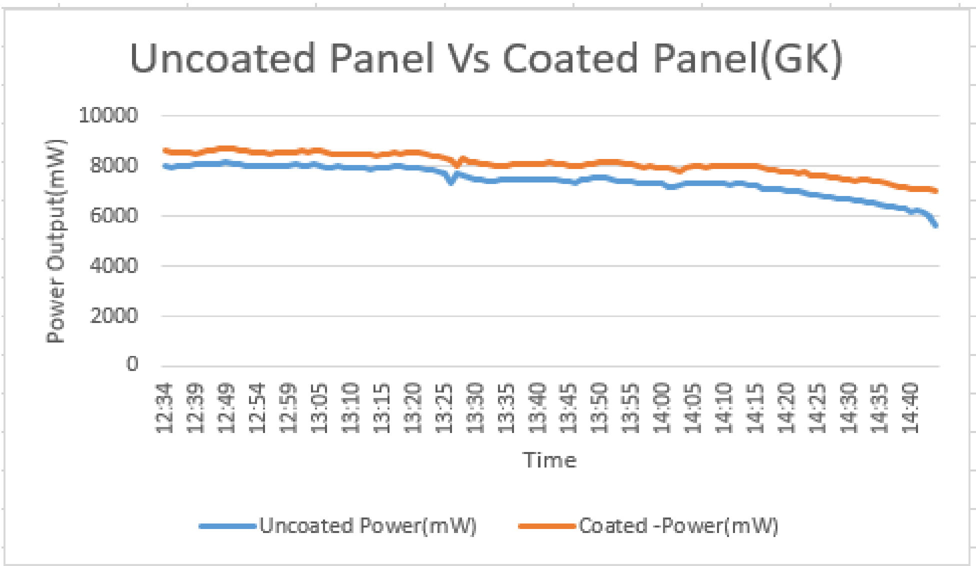
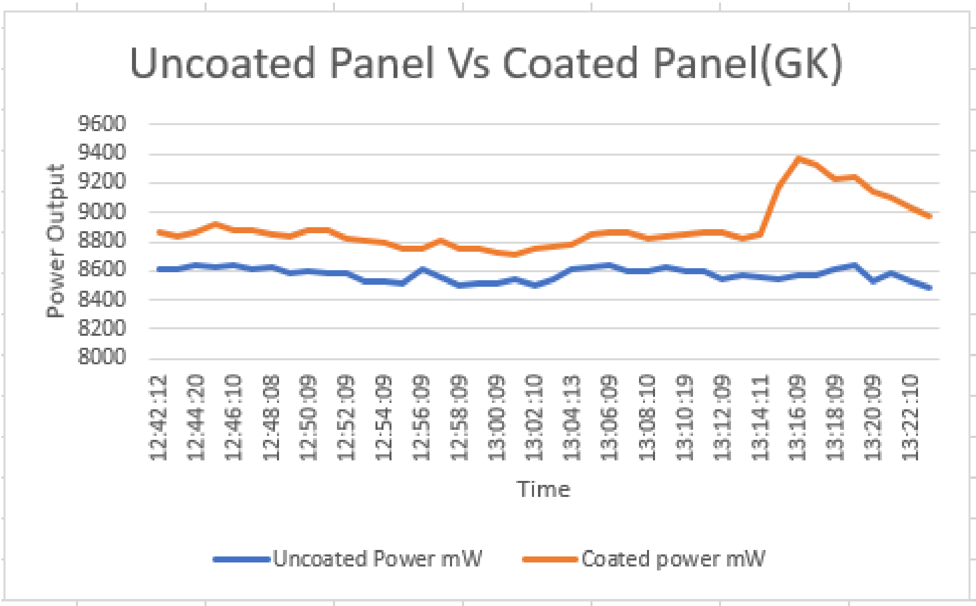


(d)

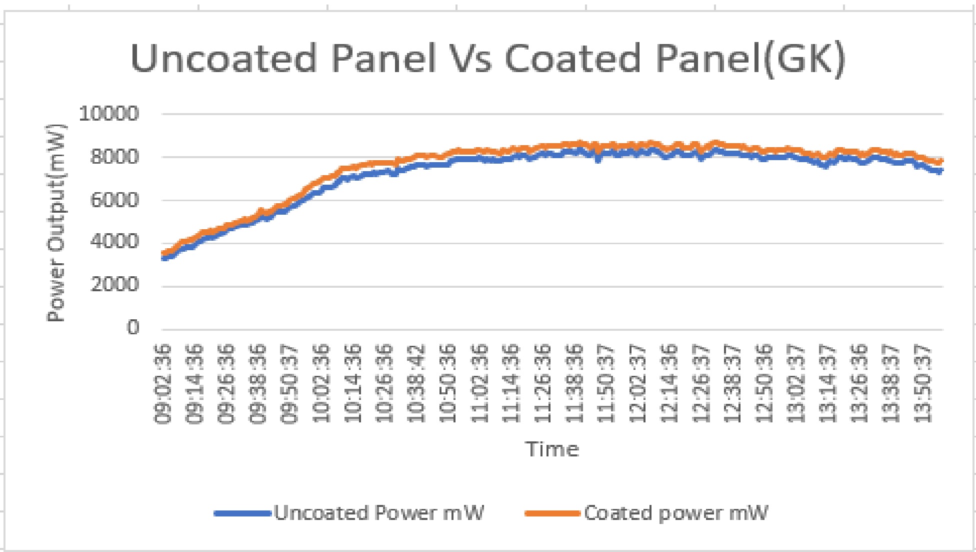
Figure 12. The time Vs uncoated and Gallium Kailashpati coated panel power output in (a) Day1, (b) Day2, (c) Day3 and (d) Day4



(a)



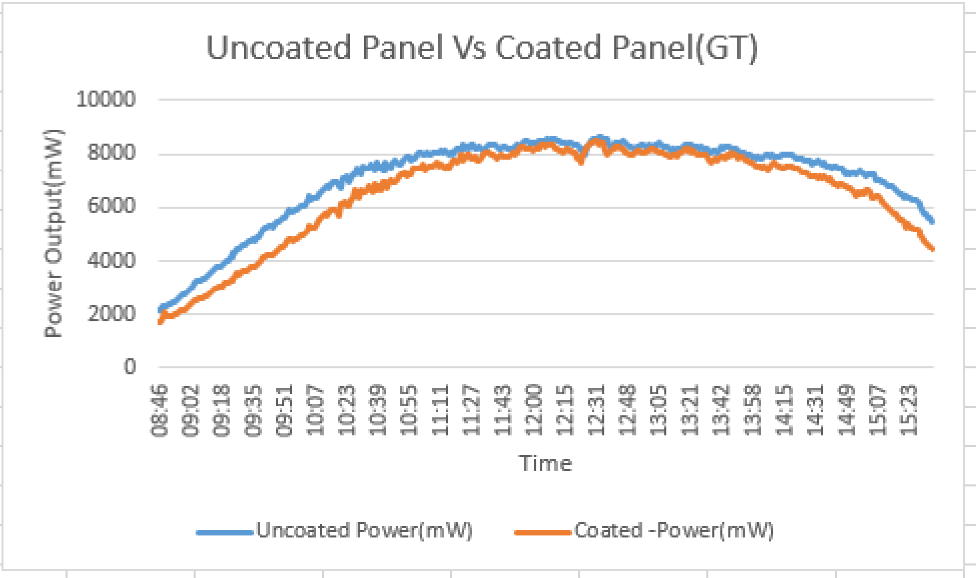
(b)



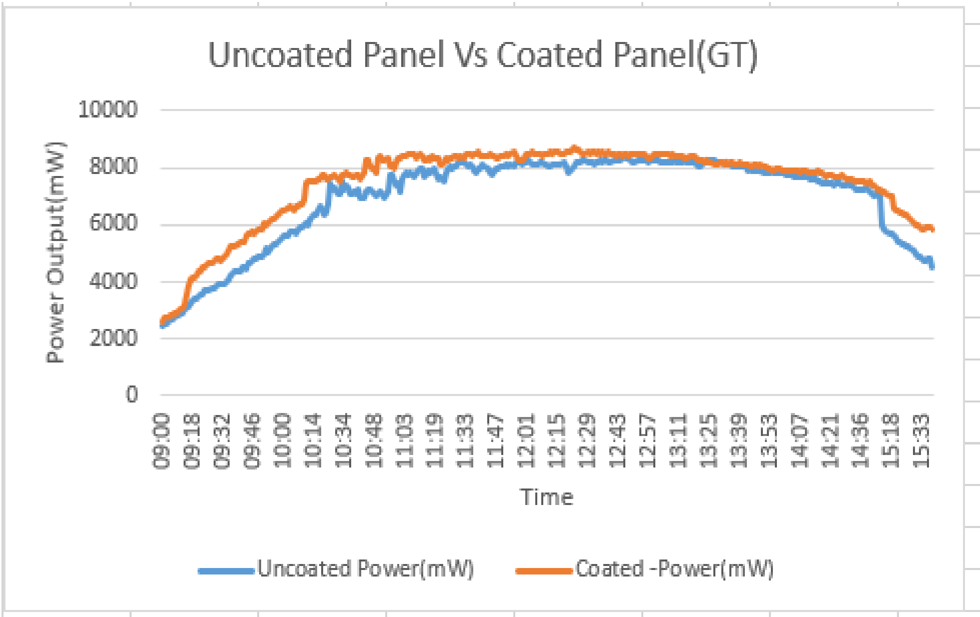
(c)

Figure 13. The time Vs uncoated and Gallium Kailashpati coated panel power output in (a) Day5, (b) Day6 and (c) Day7

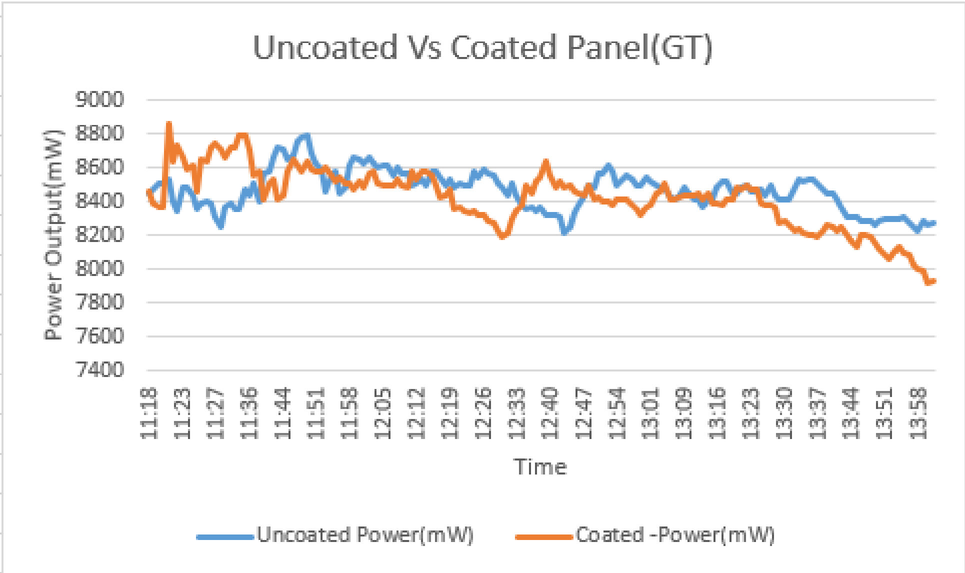
4.1.4. Performance of Gallium Triphala(GT) Coating



(a)



(b)

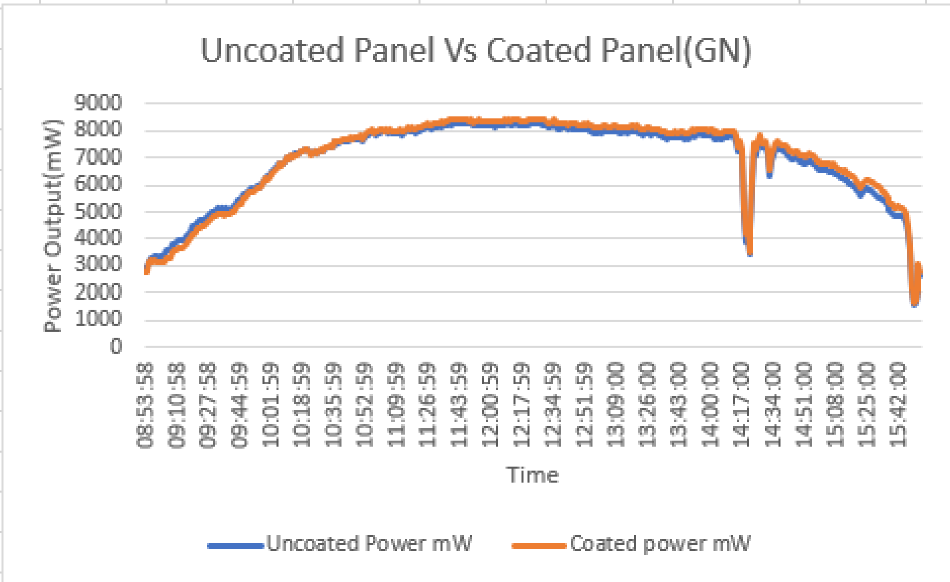


(c)

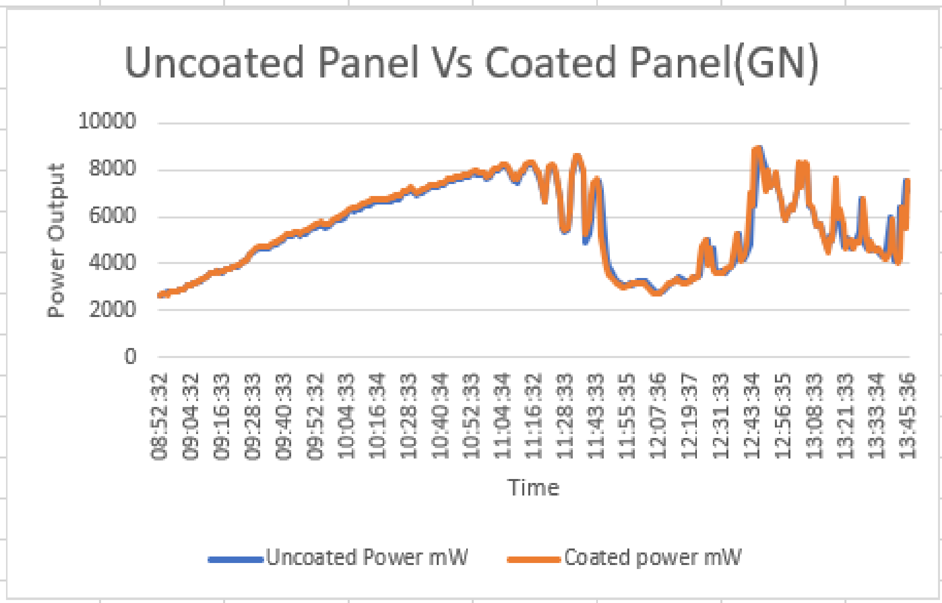
Figure 14. The time Vs uncoated and Gallium Triphala coated panel power output in (a) Day1, (b) Day2 and (c) Day3

Figure 14 displays a graph of the output power of a panel with and without a gallium triphala coating on various days. Figure 15 displays a graph of the output power of a panel that has been uncoated and coated with gallium neem across a range of days.

4.1.5. Response of Gallium Neem (GN) Coating



(a)



(b)

Figure 15. The time Vs uncoated and Gallium Neem coated panel power output in (a) Day1 and (b) Day2

Under ideal conditions, the provided composites will significantly impact the performance improvement caused by antireflection coating to a greater extent, but there is a chance that occasionally the values obtained in terms of experimental results may not always be this optimistic. The varied times of the year and seasons when the composite coating may see a reduction in efficacy might be the cause of this. In order to prevent ambiguity in the process, it is quite prudent to regularly check the coating quality. The amount of sunshine that hits the PV panel is also very important for achieving the solar irradiance and reflectivity coefficient with positive values as opposed to negative ones.

5. Conclusion

The procedure for preparing the nano particle anti reflecting coating was studied and followed to prepare the solution which was applied over the glass of the existing polycrystalline solar panel. Finally, the gallium chloride monometallic nano particle was prepared successfully. Synthesis of different natural extract for monometallic nanoparticle was done. According to the result it is observed that the output of the panels coated with GK and gallium JF gave more power output in comparison with the uncoated panel. The average gain improved by GK fruit coating was 6% and by gallium JF coating was 5%. The gallium chloride monometallic nanoparticle solution was applied over the existing polycrystalline solar panel using spraying technique. The uncoated and coated panel was tested under the sunlight throughout the day every second for many days.

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