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literature review

Summarizing a papers entitled" Influence of Temperature and Illumination on Methods for Determining Silicon Solar Cell Series Resistance"

Preparation

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Summary

The sun-based photovoltaic (PV) frameworks are confronted with significant challenges as a result of inevitable flaws in their framework, prompting more divergence of yield influence from the information influence level. This effect is known as a crisscross effect, and it is available in PV frameworks. Numerous calamities are encountered in the PV framework, and it is difficult to minimise such misfortunes. The influence of warm on the sun-based PV framework is considered in this study, and its effect on the display of activity, fill factor, open circuit voltage, and short out current, band hole level of different semiconductor materials, yield power, and proficiency is discussed.

The temperature impact of a solar-powered PV cell while interfacing in a 36-cell module is investigated using MATLAB programming for various association setups such as Simple Series arrangement (SS), Series-Parallel arrangement (SP), Total-Cross Tied arrangement (TCT), Bridge-Linked arrangement (BL), and HoneyComb arrangement (HC). Increases the temperature of various association configurations while decreasing their open circuit voltage and series opposition. Temperature may have an effect on shunt blockage and current but not fully.

Finally, this problem causes a warming effect on the sun-oriented PV cell, reducing the life expectancy of the photovoltaic board bit by bit. During construction, the temperature of attaching points is influenced, and the cell epitome is influenced. The functioning of sun-based cell materials changes when the temperature changes, as do variations in the band hole. The heat generated on the PV cell as a result of inner opposition effects the presentation characteristics of the sun-oriented cell. The open circuit voltage and series opposition were essentially influenced by temperature variations, and these progressions are also dependent on the arrangement plans of solar PV cells in a PV module. Using the MATLAB tool, the current-voltage execution bends of several association setups were displayed to concentrate on the influence of temperature. Shunt protections are generally stable, and current value also remains constant with temperature range.

The effect of temperature variation on solar PV cell series obstruction, shunt opposition, fill factor, temperature variation in voltage, and current characteristics are categorised and broken down. The sun-powered cell is made of several materials with varied bandgaps and is framed to

achieve different temperatures. The illuminating force of sunlight was discovered to have an effect on interior temperature.

References:

Ponnusamy, L., E, N., desappan, D. (2014). An Investigation of Temperature Effects on Solar Photovoltaic Cells and Modules. *International Journal of Engineering*, 27(11), 1713-1722.

Summary

This article defines the Effects of light intensity on solar cell parameters. Polycrystalline silicon solar cells are fundamentally significant in the photovoltaic industry. The application is based on the intensity of changing irradiance. Voc, Ise, and FF are performance metrics that are intimately connected to Rs, Rsh, and Is. The parameters are determined by irradiance, temperature, saturation current, series and shunt resistance, and photocurrent. The intensity of illumination has a major impact on short circuit current, which has a usual range of 160 - 1000 W/m2. The photocurrent is equal to ise. According to several calculations, open circuit voltage rises with increased irradiation, but it is less responsive to light intensity than short circuit current. The voltage varies from 0.565V to 0.616V. Fill factor increases somewhat with intensity for low irradiation, but declines with increasing intensity owing to series resistance. When the irradiance is less than 400W/m2, the efficiency improves logarithmically; when the irradiance ranges from 160 to 1000W/m2, the efficiency ranges from 3.14 percent to 15.59 percent. In the range 160 to 1000, the saturation current grows exponentially with irradiation.

The rise in recombination current causes an increase in ideality factor and saturation current. The latter is connected to an increase in the number of defect states in the band gap. Defects are created by the release of energy during the recombination of electron hole pairs; hence, as the electrons and holes recombine, the atomic bonds are disrupted by the low energy released. Following broken links are fault states that create more recombination sites. The number of recombination sites enhances the recombination of election hole pairs. Shunt resistance is relatively stable up to 200W/m2, but drops between 200 and 1000W/m2.

Short circuit current, photocurrent, ideality factor, and power are all directly proportional to irradiance intensity, but open circuit voltage works logarithmically. Fill factors function as an anamoly, increasing significantly at first then decreasing as intensity increases. Conversion efficiency rises at first, but at greater levels, it operates inexorably. Saturation current is the only way to rise exponentially. Series resistance is also included in variance, whereas shunt resistance functions continuously but declines in high ranges.

References:

Chegaar, M., Hamzaoui, A., Namoda, A., Petit, P., Aillerie, M., & Herguth, A. (2013). Effect of Illumination Intensity on Solar Cells Parameters. Energy Procedia, 36, 722–729. https://doi.org/10.1016/j.egypro.2013.07.084

Summary

Solar energy is converted to electricity using semiconductor materials. A photovoltaic generator's primary component is the solar cell, also known as a photovoltaic cell. It is made up of a semiconductor material, usually silicon, that has been doped. The elements that determine shunt resistance and series resistance have been explored in this article. Semiconductors are used to convert solar energy to electricity. In the study of solar cells, temperature, carrier production, and recombination velocity are all essential elements. During this research, the photo current density, photo voltage, angular frequency, and junction recombination velocity were all kept in mind.

Temperature and leakage current have an inverse relationship with shunt resistance and amplitude of shunt resistance. As the temperature rises, K.E rises as well, resulting in carrier collisions and leakage current. The modulation frequency has a limit of 106 rad/sec. As the temperature rises, so does the amount of solar energy available. When T is very high, there is a probability that a short circuit will occur. The higher the number of charge carriers, the higher the likelihood of a high T, and hence causing a short circuit. The arrival of charge carriers reaching the junction rises as the recombination velocity increases. Because voltage and current are inversely linked, current decreases, resulting in lower dynamic conductivity and higher shunt resistance. Shunt resistance is always in a positive phase. High modulation frequency prevents solar cell relaxation, and the photocell's response is effectively nil at this point.

The rear surface of a solar cell is extremely temperature sensitive. The density of the minority carrier increases as the temperature rises. The density of the minority carrier in the solar cell's base is determined using photocurrent and photovoltage expressions. Following two operating points, the frequency for varied growing temperature and junction recombination velocity values allowed the expressions of series and shunt resistances to be established. The operating temperature, which is a critical parameter in the behavior of solar cells and the modulation frequency, affects parasitic resistances. A rise in the desired electrical characteristics appears to be noticed regardless of temperature ranges. The series resistance that defines ohmic losses as being less than the photocell is ideal. The photocell is best if the shunt resistance (Rsh) describes the leakage current as larger. It may be determined that a rise in material temperature adds greatly to the photocell's performance deterioration.

A positive temperature gradient causes the diode's resistance to rise. We'll need an analogous electrical model of a solar cell in an open circuit to calculate series resistance. Resistance is low in the low T series. Increasing the angular frequency will also raise the series resistance. The recombination velocity at the junction determines the series resistance. When V recombination rises, the semiconductor junction acts as a resistance, resisting current flow. When more electrons travel via a junction, metal grids grow heated. With modulation frequency, the phase of series resistance varies as well. If the modulation frequency is less than 104rad/sec, the series resistance phase rapidly increases. Therefore, Performance of photo cell is best when modulation frequency is low because series resistance is inversely related with T.

Reference:

Sahin, G. (2016). Effect of Temperature on the Series and Shunt Resistance of a Silicon Solar Cell under Frequency Modulation. Journal of Basic and Applied Physics, 5(1), 21–29. https://doi.org/10.5963/jbap0501003

Summary

In this article, influence of temperature on methods for determining silicon solar cell series resistance is entitled. Resistance in a series R s is one of the most critical factors impacting the performance of solar cells, especially those that operate under concentrated sun radiation. The relevant parameters were extracted from the measured I – V characteristics of the cell at various illuminations and cell temperatures to produce R s values. According to these methodologies, the obtained R s values, as well as their trend with temperature fluctuation, differed substantially from one another. Researchers are interested in photovoltaic cells because of their high yield and high temperature, which decreases the efficiency of solar cells. For precision, many parameters such as diode saturation current, series and shunt resistance, idealist factors, and photocurrent are kept. The resistance of the contact strip, fingers, diffused layers for carriers following the finger, bulk area, and bottom electrode, among other things, is a crucial characteristic that affects efficiency. The power-consuming parameter reduces output power, implying a fall in the full factor. Each 0.5ohm increase in series resistance reduces it by 2.5 percent.

The impact of temperature is investigated using a square shaped monocrystalline Si solar cell with I-V characteristics at temperatures of 10°, 25°C, and 50°C. The voltage and current are checked using a high-speed computer-based data system. The cell is mounted on a mounting block that includes a temperature controller. The effects of various adjustments in components may be noticed. For illuminations, area approaches show a negative trend, but one diode and two diode methods show a positive trend with temperature. Using temperature-related procedures, various findings were obtained and analyzed in this manner. Techniques were also employed to determine the cells' resistance. As a result, it may be stated that there is no precise way for determining the value of series resistance. There is no precise way for calculating the value of the series resistance. To verify any derived approach for estimating the solar cell series resistance, modelling should be verified with measurements.

References:

Sabry, M., & Ghitas, A. E. (2007). Influence of Temperature on Methods for Determining Silicon Solar Cell Series Resistance. Journal of Solar Energy Engineering, 129(3), 331–335. https://doi.org/10.1115/1.2735350

Summary

This research examines the most recent developments in the use and advancement of infrared imaging approaches for rapid and spatially resolved silicon sunlight-based cell depiction. Electroluminescence (EL) imaging, photoluminescence (PL) imaging, and lock-in thermography are three infrared imaging technologies (LIT). We present fresh insights into the concept of neighbouring series safeguards as well as major thoughts on neighbourhood intersection breakdown in current multicrystalline silicon solar cells. Significant advancements have been made in the materiality of infrared imaging methods for in-line use in silicon solar cell production. Band-to-band luminescence may be detected using both silicon and InGaAs sensors. The lock-in thermography methods detect heat radiation released by the solar cell at close to ambient temperature. Light-Beam Induced Current (LBIC), local PhotoConductance Decay measured by Microwave Reflectivity (MW-PCD), and Modulated Free Carrier Absorption were all well-established techniques for measuring minority carrier lifetimes and diffusion lengths. These approaches have various drawbacks, the most serious of which is the slow pace caused by scanning operations.

An in-depth analysis of local intersection breakdown was conducted using current DLIT techniques. Warm breakdown occurs when the junction temperature rises to the degree where silicon turns out to be inherently conductive. Burrowing operations from the n-doped zone into the valence band for Zener breakdown should be possible due to the band structure at the junction. "Problem zones" caused by neighborhood breakdown or shunts can affect the cell and the module. Another breakthrough in current creation control is the evaluation of the (harmony) temperature distribution on the cell. There are three drawbacks to this method: A sequestered cell's propagation is different from that of an overlying module. Dim lock-in thermography is used to provide a picture of the horizontal appropriation of privately spread power thickness. Estimation times are typically 10 milliseconds on the request. The resultant image may then be broken down using predetermined limit settings, and a decision for extra processing can be made organically. Another method for estimating surface recombination speeds that is based on glow imaging has been developed.

References:

Kasemann, M., Kwapil, W., Walter, B., Giesecke, J., Michl, B., The, M., ... & Glunz, S. W. (2008, September). Progress in silicon solar cell characterization with infrared imaging methods. In *Proceedings of the 23rd European Photovoltaic Solar Energy Conference, Valencia, Spain* (pp. 965-973).