**Efficiency of Solar PV Enhanced by Using Phase Change Material (PCM)**

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**ABSTRACT**

The power competence of a solar [photovoltaic](https://www.sciencedirect.com/topics/engineering/photovoltaic-panel) (PV) is extremelybased on its temperature. Once the temperature of a PV enhanced, its electriccompetencereduced. By the help of  [Phase Change Material](https://www.sciencedirect.com/topics/engineering/phase-change-material) (PCM) is individual of the greatest hopeful apparatuses present days to decrease and control the temperature of a PV plate and to enhance its electriccompetence. The presenteffort is related on investigationalmethod of the consequence of using clean PCM (like-Glauber Salt, nano materials, natural materials) in the [temperature Characteristics](https://www.sciencedirect.com/topics/engineering/thermal-behaviour) as well as electrical operation of a PV panel. A passing power stability is similarly obtainable to analyse the structure thermal Characteristics and associate it to the electric productivities. To advance, a suitable investigational system was developed and two models were constructed and verified. Model 1 is shaped from a sample case and contains of a viewpoint, a PV panel without PCM. Models 2 are intended with a container additional at the back face of individually PV panel that holds clean PCM and mutual PCM correspondingly.

 **Keywords:** Phase Changing Materials, Efficiency, Power, Energy,

**CHAPTER-1**

**I. INTRODUCTION**

1. **Power From Brightness**

The power is accepted during liberty as electromagnetic energy. The numerous categories of electromagnetic energies are available. Bright is first kind and Radio emission are additional. Electromagnetic energy journeys similar emission in streams. Similar to stream waves, it is a sequence of picks and falls. A Single numerous categories of electromagnetic emission vary is in the wave extent. The method is the distance among double picks (or double falls) in a line. The radio emissions have lengthier wavelengths as compared with bright. Between categories of bright, blue has a smaller wavelength than red. Solar Compartments use Bright. Lone portion of the power directed to Ground by the Sunlight essentially makes it to Earth’s superficial. Approximately solar power becomes bounded spinal into planetary. Around becomes engrossed with the wind. Utmost the sunlight irradiation is to prepare it towards global superficial is that method of noticeable light. PV cells are able to practice with the power of particular bright towards harvest power. Nonetheless they do not effort similarly fine through all methods of light. Dissimilar categories of solar cells practice dissimilar wave extent. The resources of cell can practice solitary a number of the sunlight power with the purpose of accepts.

1. **Energy**

Energy is a torrent of miniature atoms named current. The torrent is named an stimulating current electron or current. Around mention the types of electric current as follows. First is direct current (DC). It continuously movements in the similar way. The solar PV and battery produce DC. The next type of electric current is Alternating (AC). Its opposites way numerous periods a second. The Grid and regular most home equipment’s are act only AC power.

1. **Mensuration Electricity**

The power of electricity is defined as the amount at which electric energy used. The unit of power is watts. A 100-watt bright light is extra influential as compared with 60-watt light. It practices extra power. Additional significant element is denoted as watt-hour. It calculates the electric power created else applied throughout the time period. It generations one watt of energy completed a time of one instant. A comparable however greater element is denoted as kilowatt-hour. The method of 1,000 watts is completed an instant. A 100-watt bright light is to breaks on behalf of 10 instant usages 1,000-watt hours of electric energy. Here the expanse similar to like 1kilowatt-hour.

1. **Characteristic Requests of PV**
* Stand-alone energy structures for lodges and isolated houses
* Isolated telecommunication locations for conveniences and the military
* Water propelling for agriculturalists
* Emergency sound packets for highways and college sites
* Street Illumination
* Grid Associated source of power
1. **Solar Power Selections**

Solar energy has the utmost possible of all the bases of non-renewable energy and it will be one of the greatest significant bases of power particularly when additional bases in the nation have exhausted. Solar energy might source all the current and upcoming energy requirements of the global on an involving source. This creates it one of the greatest hopefuls of then on conventional energy bases. Solar energy can be key bases of power. Its latent is 178 billion MW which is around 20,000times the global request. The energy emitted by the sun on a cheerful luminous day is around 1KW/m2. The tricky related with the practice of solar energy is that its obtainability differs extensively through period. The differences in obtainability happen every day, since of the day-night sequence and likewise seasonally since of ground’s revolution everywhere the sun. In extra differences happens at a particular position since of resident weather condition. Subsequently, the energy composed with the sun is outstanding must be stored for us throughout periods when it is not obtainable.

Efforts have remained completed to create us of this energy in rising steam which might be cast-off in powerful the prime movers for the determination of generation of electric power. Nevertheless, outstanding to great space necessity and indecisively of obtainability continuous rate this technique develops unsuccessful. Photovoltaic cell is a different equipment used for power making which changes suns energy directly into electric energy. Therefore, power produced can be stored and applied.

1. **The Request of Solar Power**
* Boiler and refrigeration of housing structures
* Solar water boiler
* Solar ventilation of farming and animal crops
* **S**olar condensation on a minor municipal measure
* Salt manufacture by vanishing of salt-water or inland brines
* Solar ovens
* **S**olar trains for water propelling
* Food chilling
* Bio adaptation and wind energy, which are secondary basis of solar energy
* Solar heaters
* Solar electric power making
1. **PV Cell**

PV cells originate is the numerous dimensions. A few are smaller and others a brand. A few are 5 inches (12 centimetres) transversely. Here cell is too completed the category of substance identified seeing that a semiconductor device. Repeatedly, thus is too completed the silicon. Semiconductor unit be able to behaviour, otherwise transmit, power. Thus, is do not prepare this in addition to alloys, though. This is anywhere that is named “semi.” Since this lone “semi” behaviour power, this be able to cast-off towards switch exciting power. Happening that the upper and lowest this characteristically includes metallic associates in excess of while power be able to stream. The characteristic effortless cells have double coatings of silicon. Primary that is recognized as n-type. Then additional is p-type. These coating is dissimilar as of individually previous.



**Figure1: Solar Cell**

1. **Power Produced from Solar Cell**

The procedure of creation power starts at what time silicon particles take up about light. This glow’s (Light) power collisions about electric atom away to the particles. Thus, electric atom movement is among the double coating. This movement create the electric power. This power cans permission the unit completes the metallic associates in addition towards be second-hand. Once glow successes a sunlight cell, considerable that the power is to misuse. Approximately glow bounds off otherwise permits complete that unit. About that as twisted interested in temperature. Solitary luminosity through the suitable wave lengths otherwise colours, which collected and afterwards twisted, interested in electrical energy.

1. **Solar Modules**

 The sole easy PV cell creates solitary small electric power. The ultimate objectives of method, cells are frequently related composed in cluster identified as PV mechanism. Thus, PV mechanisms have an edge so as to grips that the segments. A number of components is to numerous bases extended as well as broad. This typically is able to harvest active towards a not many hundred watts of electric power. If additional energies are required, components are able to be combined composed towards system at great.



**Figure 2: Solar Modules**

1. **Solar Array**

Module is occasionally named PV panels. The more no of PV panels collected is named array. Similarly, occasionally named PV panels. Anything that the demand a collection of PV cells, the detail leftovers: than extra segment have connection composed, the extra power that is created. Through sufficient components, enormous quantities of power are likely. A decent illustration is an innovative power plant existence constructed at Moura in Portugal. The first stage of the scheme has 262,080 solar modules, individually through 48 cells. They will harvest up to 46 megawatts of power.



**Figure 3: Solar Array**

1. **Solar Cell Gets**

Once specialist’s compilation PV cells, first item are appearance on what rate expensive the segment is. Which it prices high, nonentity will purchase it. One problematic through the primary PV segments were too the typically price additional after that various energy basis. Thus, the methods are wherefore the initial significant usage of sunlight units are in planetary satellites. Around there for this is no inexpensive behaviours towards create power within planetary during the year 1950s. Additional entity specialists’ appearance on be a unit “competence.” Thus, expresses how decent a unit is on with sunshine. The great-effectiveness unit tries additional to the sunshine’s power converted to electrical power after that a small-competence unit.

Always after those solar cells are conceived, experts contain operated towards create the inexpensive and extra competent. Around have been portions of advancement. Thus, primary solar cells have a competence of fewer compared to 4 percentage. Now a day’s units price the portion less, in addition to numerous include a competence of 15 percentages otherwise extra. About investigational units prepare level improved.

1. **Photovoltaic System Sizing**

Sizing a photovoltaic structure for a stand-alone photovoltaic energy model includes a five-step development which will permit the photovoltaic model fashionable or operator to precisely size a structure related on operators’ predictable requirements, areas and economical. Photovoltaic structure sizing related on,

* + - **A**pproximating the electric load
		- Sizing and stipulating an inverter
		- Sizing and stipulating batteries
		- Sizing and stipulating an array
		- Stipulating the controller

**II. LITERATURE SURVEY**

Silicon Solar PV demonstration the energy droplet higher than 25 °C board heat through a hotness constant reaching since −0.29%/K up to −0.649%/K [1,2] dependent happening category the solar cell in addition to engineering knowledge [3]. Numerous scientific associations contain be established towards designate thus requirement the solar functioning heat happening climatically circumstances and solar resources [4]. Thus, operative heat touched with solar panels in addition to related energy droplet mainly related taking place thus environment on the location. The Germany 51% of the PV power occurrence happening a solar array be overhead 602 W/m2, whereas during Sudan thus worth ranges 82%, subsequent during dissimilar working heat as well as related energy droplet [5,6]. The extreme solar functioning heat as 130 °C have be described within southern Libya (28.1°N and13.9°E) subsequent inside a 70% decrease into the minimal energy [7]. In sensible working heat boundary is favour of solar choices as of −41 °C to 84 °C [8] though within warm as well as dry environments, solar heat regularly growths overhead higher boundary of heat variety [7], where consequences during heat persuaded energy disappointment in addition to solar unit desalination along with quick decreasing [9] opinion a robust essential in favour of solar heat directive towards exploit together board energy production as well as lifespan. Dynamisms 2014, 7 1320.Dissimilar inactive and energetic temperature elimination methods have been cast-off to uphold PV at minor heat. Passive temperature exclusion in permitted stand up PV trusts taking place optimism ambitious wind movement within a tube late thus solar [10]. Temperature exclusion rest is taking place relation the distance towards interior width (L/D) on tube [11] with the extreme temperature exclusion available by the side of the L/D at 21 [12]. Inactive temperature exclusion within construction combined solar PV (BIPV) trusts taking place optimistic movement the wind during the initial otherwise wind networking its place the tube, overdue on solar [13]. The study examination for optimism determined wind movement within the initial overdue an concealment combined solar obtainable the highest value as 6 °C heat decrease during be everywhere even hotness subsequent during the next 2.6% rise during annual electric production on solar [14]. However, thus heat decreases as well as related anticipation the energy droplet be actual little during kind of solar schemes, developments be able to survive entire with increasing temperature transmission done hang up metallic pieces as well as introducing fins thus wind station as well as enhancing to station arrangement [15,16]. Energetic chilling the solar trusts taking place wind otherwise stream movement happening thus obverse otherwise rear surface of PV superficial. Thus, consequence wind movement on dissimilar bay rates in addition to wind holes taking place obverse lateral as well as rear lateral the solar PV heat be demonstrated along with a extreme 33.9 °C heat reduction be projected on wind bay rapidity the 1 m/s along with obverse as well as rear wind break is 21 mm [17]. Water movement taking place obverse superficial on the self-supporting solar PV have reduced unit heat awake to 23 °C beside through reducing reproduction sufferers as of solar PV superficial harvesting an 8.5%–9.3% growth inside electric energy production [18]. Water movement taking place a rear the concealment combined solar have supposedly exposed best electric as well as current presentation on the water movement amount as 0.06 kg/s in favour of a specific scheme during climate circumstances of Hefei, China on sunlight energy strengths as 404 and 431 W/m2 [19]. Inactive chilling of building integrating PV through firm-fluid cooling materials be empirically as well as mathematically accessed via an paraffin shine while cooling PCM as well as a four-sided aluminium bottle by interior measurement as (301 mm × 133 mm × 41 mm) consuming discriminating enclosed visible superficial through a MAXORB (as long as by INCO Discriminating Exteriors, Hereford, UK) discriminating solar fascinating movie while have radioactive belongings like towards silicon in the direction of impersonator a coating the solar unit [20] devoted towards thus superficial. Heat delivery on the obverse superficial as well as confidential on cooling PCM be forecast finished two dimension in addition to three-dimension limited capacity temperature transmission replicas and were empirically authenticated [21,22]. Construction on this effort, Hasan et al. [23] invented and considered four dissimilar temperature basins devoted towards solar cell to examine act the 5 dissimilar categories the cooling PCM towards discovery elsewhere on best PCM as well as thus temperature basin in favour of thus submission. The 2 kinds of PCM, a eutectic combination the notion acid-palmitic acidic, PCM1 in addition to an salty CaCl2·6H2O, PCM2 as well as an aluminium created temperature basin were initiate hopeful.

1. **Observing Back**

**E**dmond Becquerel of France primary observed so as to glow be able to reason resources towards produce power. Thus, be the year 1839. Additional experts advanced considered the draws among light, substance, and power. Individual were invented by Albert Einstein. The year 1905 man clarified processed the particles yield during electromagnetic energy (thus since luminosity) as well as next bounce sour electric atoms. Thus, procedure be named as photo electrical consequence. Einstein got Nobel Prize during the year 1921 in favour of this effort taking place it. Thus, Initial Sunlight units Russell Ohl was on initial individual towards originated awake through a sunlight unit similar once second-hand now a days.

The man operated on Bell Workshops inside New Jersey. The units be found that the silicon (silicon be establish inside gravel and in numerous categories of astound). The man give named as unit a “glow- penetrating electrical apparatus.” The man area in favour the copyright taking places it inside 1941. The 5 years advanced, the man get on copyright. The 1954, Bell Workshops create on initial applied sunlight unit. Thus, is primary solitary towards create sufficient power in the direction of drive normal electric apparatus. Motionless, initial units did not create more power. Similarly, they were more expensive. Their primary significant usage is in planetary satellites, preliminary inside 1958. Since units developed inexpensive, thus is cast-off during additional behaviour. In primary energy generation location intelligent towards create one MW as power through sunlight panels functioned inside Hesperia, the California, 1982. Translate the DC energy generated by the components into AC current that can lump into the prevailing substructure to power illuminations, engines, as well as additional supplementary appliances. The components during a solar arrangement are typically initial associated inside sequence towards acquire on anticipated potential energy; thus, separate string is formerly associated during equivalent towards permit thus arrangement to harvest extra power. Sunlight arrays is characteristically calculated by the electric energy they harvest, in watts, kilowatts, or even megawatts

**III. SIGNIFICANT CHARACTERISTICS WITHIN SOLAR PANEL FITTINGS**

Sunlightabsorption methods are best one. This not only considers as photovoltaic (PV) components a best choice to produce micro energy also, other than thus similarly deliver fresh, non-conventional energy. Previously working in front towards connect otherwise acquire a sunlight construction; the methods have convinced limitations to describe the belongings, so need do understand the characteristics.

 The subsequent is quantities of significant characteristics on sunlight construction connections. The significant towards communication so as to these characteristics is resulting below benchmark examination circumstances (BEC). BEC in favour of sunlight construction is unit temperature of 25°c, sunlight irradiation as 1000W/m2 in addition to impressive concentration as one.

* **Highest Power (Pm)**

Pm is denoted uppermost energy production on the sunlight construction below benchmark examination circumstances (BEC). Thus, are rate to greatest mention towards since as “size” to sunlight construction, in addition to the calculated as Watts. The current with related to potential energy curve, thus Pm are resulting since to extreme energy indicate with increasing to current with respect potential energy on thus tip. Thus, kind of developed charges are extra “influential” in sunlight construction.

* **Potential energy on highest Power (Vmaxp)**

Thus, Vmaxp are produced potential energy with thus sunlight construction once thus energy productions are uppermost. The real potential energy so as to sunlight construction must deliver at what time has associated towards a charge manager otherwise an inverter below benchmark examination circumstance.

* **Current on greatest Power (Imaxp)**

**The** Imaxp are produced current (amps) with thus sunlight construction at what time thus energy production is as uppermost. Thus, is real current the sunlight construction must deliver at what time associated towards PV apparatus below benchmark examination circumstances.

* **Open path Potential (Vpp)**

Open path potential is quantity denoted as volts thus sunlight construction produces through without appliances transversely (during a open path). Thus, are attained with gauging among a potential meter transversely as optimistic as well as unenthusiastic points. Subsequently without appliance is associated towards PV, the does not produced current. The Vpp are most significant characteristics, since have resolute thus quantity on sunlight construction be able to attach during sequence.

* **Short path Current (Ispc)**

Short path Current are quantity on electric current sunlight construction production at what time non associated toward on appliance. The methods are calculated through making on petite path among the optimistic in addition undesirable mains. Once defining in what amount amps associated equipment like the inverter otherwise the sunlight power charger capable to survive, thus Ispc are cast-off. This are commonly increased by 1.26 aimed at security necessities.

* **Sunlight Board Competence**

Sunlight Board competence are entire quantity on sunlight power capable to transformed obsessed by real power through the sunlight construction, below benchmark examination circumstance. The high effective sunlight boards are taking active somewhat fewer place that harvest the equivalent quantity of energy after that fewer effectual system.

* **Heat constant of Pm**

The extreme energy production on sunlight constructions is contrariwise relative toward heat i.e., thus energy production reductions by the growth in heat. The heat constant on Pm (extreme energy), are the rate signifies to percentage alteration during energy production each rise to heat (%/°C). The heat constant as Pm -0.8%/ °C resources thus extreme energy production to the PV component reduction through 0.8% for each grade increase in heat.

* **Heat constant of Vopc**

The methods are calculated to level through on open path potential energy as sunlight construction is pretentious through on alteration during the heat. Thus, open path potential energy frequently reductions through growth on heat. Characteristically, thus Vopc as sunlight board to be advanced throughout wintertime, formerly on summer.

* **Heat constant of Ishc**

Once arounds are growth during heat on sunlight board, here methods are consistent reduction to the short path electric energy (Ishc). Thus, heat constant on Ishc signifies as proportion nonconformity since to regarded short path electric energy on sunlight board once here are alteration on heat. That are calculated as %/°C.

* **Whole structure Potential energy**

The whole sunlight construction structure classically contains on array as numerous discrete sunlight board. Thus, entire structure potential energy is extreme quantity as potential energy structure to be production once board is associated composed. Thus, are creation on separate elements’ potential energy assessment then whole numeral on board cast-off. Availability of 24, 80v sunlight board is associated on sequence to the structure, thus whole structure potential energy to the 80v × 24 = 1920V. If need extra power, to construct extra board necessitate.

* **Energy acceptance**

Energy acceptance are calculated on choice to electric energy as PV component capable produce, pick value otherwise small value after that is quantified volume. The sunlight board through an energy acceptance as ±11% then an energy assessment on 202 watts capable produce the supreme 222 watts in addition a smallest as 182 watts. Thus, higher acceptance boundaries are named optimistic acceptance, that on lesser boundaries are undesirable acceptance.

**IV. PHASE CHANGING MATERIALS**

A **phase change material** (**PCM**) is a material that outward/inward adequate power on [phase change](https://en.wikipedia.org/wiki/Phase_transition) toward deliver valuable hotness/chilling. Usually, the changeover will be since one of the primary two essential [situations of substance](https://en.wikipedia.org/wiki/States_of_matter) - hard and fluid - to the supplementary. The phase conversion might similarly be among non-classical conditions of substance, such as the conventionality of quartzes, where the substantial drives incompatible to one glassy construction to compatible to additional, which might be a developed or lesser power nation. The power outward/inward through phase change over since hard toward fluid, else vice-versa, thus [temperature combination](https://en.wikipedia.org/wiki/Heat_of_fusion)s are commonly abundant developed after on [functional temperature](https://en.wikipedia.org/wiki/Sensible_heat). Snow, aimed at sample, necessitates 334.59 J/g toward dissolve, nonetheless formerly aquatic determination increases single grade additional through on adding fair 4.17 J/g. Aquatic/snow are consequently an actual beneficial phase change material then consumes remained cast-off towards stock wintertime chilly to cool constructions to summer subsequently on smallest period that on Achaemenid Territory.

Through liquefy then hardening on phase change heat (PCH), thus, PCMs are accomplished the storage in addition discharging great quantities on power associated towards [serviceable temperature](https://en.wikipedia.org/wiki/Sensible_heat) storing. Temperature is absorbed or released when the substantial variations since hard to fluid in addition vice versa otherwise once on interior assembly as substantial variations; PCM is consequently mentioned toward by way of [concealed temperature](https://en.wikipedia.org/wiki/Latent_heat) storing (CTS) resources. Here are dual major modules on phase change material: biological (carbon-comprising) resources resulting more over since fuel, after florae or since wildlife; in addition, salty hydrates, the commonly moreover usage ordinary salts after that ocean otherwise since inorganic credits else is by-crops on additional developments. The tertiary periods are hard towards dense stage alteration. PCM is cast-off on numerous dissimilar profitable requests anywhere energy storing and/or steady temperatures are mandatory, counting, amongst others, boiler pads, refrigeration for telephone swapping containers, and sartorial.

By remote the major possible market place is for construction boiler and chilling. PCMs are presently charming the proportion on consideration aimed at thus, submission outstanding towards as liberal decrease on price the non-conventional energy, attached through restricted periods of obtainability, subsequent the eccentric among highest request and obtainability of source. The Northern America, China, Japan, Australia, Southern Europe and additional advanced nations through warm days highest sources are noon and highest requests are since about 16:45 to 20:15. Thus makes on portion the request aimed at storing radio. Hard- fluid phase change resource is frequently summarized aimed at connection on termination submission, towards comprise on fluid state. The few submissions, particularly once combination towards fabrics is compulsory, stage alteration resources is [little-compressed](https://en.wikipedia.org/wiki/Micro-encapsulation). Little-compressed permits on substantial towards endure hard, during minor foams, once on PCM essential consumes molten.

**V. CHARACTERISTICS AND CLASSIFICATION**

Concealed heat storing to capable attained over variations on [state to substance](https://en.wikipedia.org/wiki/State_of_matter) after fluid→hard, hard→fluid, hard→ vapor and fluid→vapor. Though, lone hard→fluid and fluid→hard phase change is applied aimed at PCMs. Though fluid–vapor changeovers consume advanced temperature on alteration after that hard–fluid changeovers, fluid→vapor stage alteration is unreasonable aimed at current storing since great capacities otherwise great compression is mandatory towards supply on resources that the air stage. hard–hard stage alteration is characteristically actual measured in addition consume on comparatively little temperature on alteration. Originally, hard–fluid PCM perform similar [serviceable temperature](https://en.wikipedia.org/wiki/Sensible_heat) loading (TLS) resources; thus, heat increases through engage temperature. Dissimilar conservative TLS resources, though, once PCM spread the stage alteration temperature (liquefy opinion) thus engage great quantities on temperature by the practically continuous heat pending all the substantial is molten. When the ambient heat everywhere a fluid substantial reduction, the PCM hardens, discharging its kept concealed temperature. The great numeral on PCM is obtainable to somewhat mandatory heat choice since −6 awake towards 191 °C.[[1]](https://en.wikipedia.org/wiki/Phase-change_material#cite_note-Kenisarin-1) Inside on social ease choice among 22–32 °C, approximately PCM is actual operative, storage completed 202 kJ/kg on concealed temperature, thus compared towards on exact temperature volume everywhere single kJ/kg.°C aimed at stonework. Thus, storing compactness capable consequently remain 202 periods superior else additional stonework each kg uncertainty the precise heats are mandatory. Uncertainty heat alteration on, roughly, 5°C capable to allowable, thus compactness are 51 periods superior.  In exact temperature volume on aquatic are considerable developed on 4.3, consequently storing compactness on postulated PCM choices among 51 and 12.6 periods on aquatic.

**VI. METHODOLOGY**

Equipment to be connected below mentioned figure 4. The PV panel backside is coated with phase changing materials (like-Glauber Salt, nano materials, natural materials). Thus, the PCM reduces the panel temperature and improving the panel performance. Thus, the improving power is to controlled through charge controller and put it into battery. The PCM is used for improving good thermal efficiency.



**Figure 4: Schematic diagram of solar still**

**VII. CONCLUSION**

The experimental studies of the two different solar PV Panel (conventional passive solar PV and proposed PCM coated solar PV) Also, a comparative performance of the above-mentioned PV with the existing have been presented and the conclusions have been made from the practical study as follows.

1. The overall average temperature can be calculated, compared with conventional to proposed one.

2. The performance of proposed (PCM module) one is improved.

3. The Solar PV efficiency factor is mainly depending on which kind of PCM used.

**REFERENCES**

 [1]Radziemska, E. The effect of temperature on the power drop in crystalline silicon solar cell. Renew. Energy2003,28,1–12.

 [2] Radziemska, E.; Klugmann, E. Thermally affected parameters of the current-voltage characteristics of siliconphotocell.Energy Convers. Manag. 2002, 43, 1889–1900.

 [3] Makrides, G.; Zinsser, B.G.; George, E.; Schubert, M.; Werner, J.H. Temperature behaviour of different photovoltaicmsystems installed in Cyprus and Germany. Solar Energy Mater. Solar Cells 2009, 93, 1095–1099.

 [4] Skoplaki, E.; Palyvos, J.A. Operating temperature of photovoltaic modules: A survey of pertinent correlations. Renew.Energy 2009, 34, 23–29.

 [5] Bücher, K. Site dependence of the energy collection of PV modules. Solar Energy Mater. Solar Cells 1999, 47, 85–94.

 [6] Breteque, A.E. Thermal aspects of C-Si photovoltaic module energy rating. Solar Energy 2009, 83, 1425–1433.

 [7] Nassar, Y.F.; Salem, A.A. The reliability of the photovoltaic utilization in southern cities of Libya. Desalination 2007,209, 86–90.

 [8]Suntech STP065-12/Sb 65 Watts 12V Polycrystalline Solar Panel. Available online:http://www.arcmansolar.com/products/53.aspx?cid=7-12-11 (accessed on 23 October 2013).

 [9] Saly, V.; Ruzinsky, M.; Redi, P. Indoor study and ageing tests of solar cells and encapsulations of experimental modules. In Proceedings of the 24th International Spring Seminar on Electronics Technology: Concurrent Engineering in Electronic Packaging, Calimanesti-Caciulata, Romania,5–9 May 2001.

 [10] Brinkworth, B.J. Estimation of flow and heat transfer for the design of PV cooling duct. Solar Energy 2000, 69, 413–420.

 [11] Brinkworth, B.J. A procedure for the routine calculation of laminar free and mixed convection in inclined ducts. Int. J. Heat Fluid Flow 2000, 21, 456–462.

 [12] Brinkworth, B.J.; Sandberg, M. Design procedure for cooling ducts to minimise efficiency loss due to temperature rise in PV arrays. Solar Energy 2006, 80, 89–103.

 [13] Gan, G.; Riffat, S.B. CFD modelling of air flow and thermal performance of an atrium integrated with photovoltaics. Build. Environ. 2004, 39, 735–748.

 [14] Yun, G.Y.; McEvoy, M.; Steemers, K. Design and overall energy performance of a ventilated photovoltaic façade. Solar Energy 2007, 81, 383–394.

 [15] Tonui, J.K.; Trip Anagnostopoulos, Y. Air-cooled PV/T solar collectors with low-cost performance improvements. Solar Energy 2007, 81, 498511.

 [16] Fossa, M.; Ménézo, C.; Leonardi, E. Experimental natural convection on vertical surfaces for building integrated photovoltaic (BIPV)applications. Exp. Therm. Fluid Sci. 2008, 32, 980–990.

 [17] Mallick, T.K.; Eames, P.C.; Norton, B. Using air flow to alleviate temperature elevation in solar cells within asymmetric compound parabolic concentrator. Solar Energy 2007, 81, 173–184.

 [18] Krauter, S. Increased electrical yield via water flow over the front of photovoltaic panels. Solar Energy Mater. Solar Cells 2004, 82, 131–137.

 [19] Ji, J.; Han, J.; Chow, T.; Yi, H.; Lu, J.; He, W.; Sun, W. Effect of fluid flow and packing factoron energy performance of a wall-mounted hybrid photovoltaic/water-heating collector system. Energy Build. 2006, 38, 1380–1387.

 [20] Huang, M.J.; Eames, P.C.; Norton, B. Thermal regulation of building-integrated photovoltaics using phase change materials. Int. J. Heat Mass Trans. 2004, 47, 2715–2733.

 [21] Huang, M.J.; Eames, P.C.; Norton, B. Phase change materials for limiting temperature rise inbuilding integrated photovoltaics. Solar Energy 2006, 80, 1121–1130.

 [22] Huang, M.J.; Eames, P.C.; Norton, B. Comparison of a small-scale 3D PCM thermal control model with a validated 2D PCM thermal control model. Solar Energy Mater. Solar Cells 2006,90, 1961–1972.

 [23] Hasan, A.; McCormack, S.J.; Huang, M.J.; Norton, B. Evaluation of phase change materials for thermal regulation enhancement of building integrated photovoltaics. Solar Energy 2010, 84,1601–1612.