Fabrication of Solar and Rain Pressure Cells

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Abstract: The present investigation relates to Solar and Rain Pressure Cells to increase the efficiency of available solar panels which only works on sunny days. The proposed system consists of Solar panel, Piezoelectric sensors, Acrylic glass, rectifiers, battery system. This research has been improved for the purpose of generating more sustainable energy. The research on the use of piezoelectric transducer to harvest raindrop kinetic energy is gaining attention of researchers frequently.

Key Words- Pressure Cells, Hybrid Solar & Pressure Rain Cells, Piezoelectric sensors.

I. INTRODUCTION

In now a day renewable energy is highly reliable and main source of energy. It is available in many forms such as Solar, Wind, Hydro and Biogas power. Out of all these sources most stable is Solar power.

Some of the solar power plants available in India are Bhadla solar park in Rajasthan with capacity of 2250 MW, Shakti Sthala solar power project in Karnataka with capacity of 2050 MW, Ultra mega solar park in Andhra Pradesh with capacity of 1000 MW.

But some locations like Pune, Mumbai, Bangalore etc in these places high rainfall is noted for long duration of the year than normal. So power generation from rain drops is very useful. The utilization of rain drop energy is conventional as demand variation.

Generally, rain water is collected in a dam which later passed through the turbine and electrical power is generated.

In this project piezoelectric material is used which is combined with solar panels. This is to ensure and magnify the power generations by rain water at roof tops.

The piezoelectric sensor will convert the pressure energy of the rain drop generated by their fall on the panel into electrical energy. The connection of piezoelectric sensors can be arranged in both parallel as well as series manner. The implementation of hardware and effectiveness of piezoelectric sensor can be observed in different rainy and weather conditions.

How can we generate electrical power from rain drops?

Well a rain drop is not entirely water it is mixed with salt which gives a narrow way to form ionic charges with suitable sensor. Research shows that in this regard Grapheme (1 – atom – thick) layer of carbon can be used to manipulate positive ions towards itself. As we are always in search of more sustainable energy Solar power gives some promising result but that can only be accessed in day time depending on the weather conditions. Generation of electrical power from rain drops is an betterment in arena of power consumption, Later times this project will be defining properties of piezoelectric materials and generation of electric power from rain drop as well as solar energy.

1.3 Solar Power Plant – Main Components, Working, Advantages and Disadvantages

Knowing the fact that fossil fuels are not going to last forever, solar power generation seems to be leading the path in clean and renewable energy generation among all other renewable sources of energy production. China which once seems world's largest polluter has now developed the largest solar power plant. Further-more by 2020 India is aiming to produce 100,000 MW of electricity from solar power plant only.

Tesla has taken the initiative to power up the Kauai island of Hawaii through solar power plant only. Tesla is providing its industrial battery packs, to store the energy of sun to be used at night. They are ensuring that they can light up the entire island without sunshine for as long as 3 days. And gets recharged back in just 7 hours of sunlight, isn't that amazing!

Efficient production of power from sunlight is the leading topic of research all around the globe. Let's just figure out what it takes to convert sunlight into electricity.

1.3.1 How does a Solar Panel Converts Sunlight into Electricity?

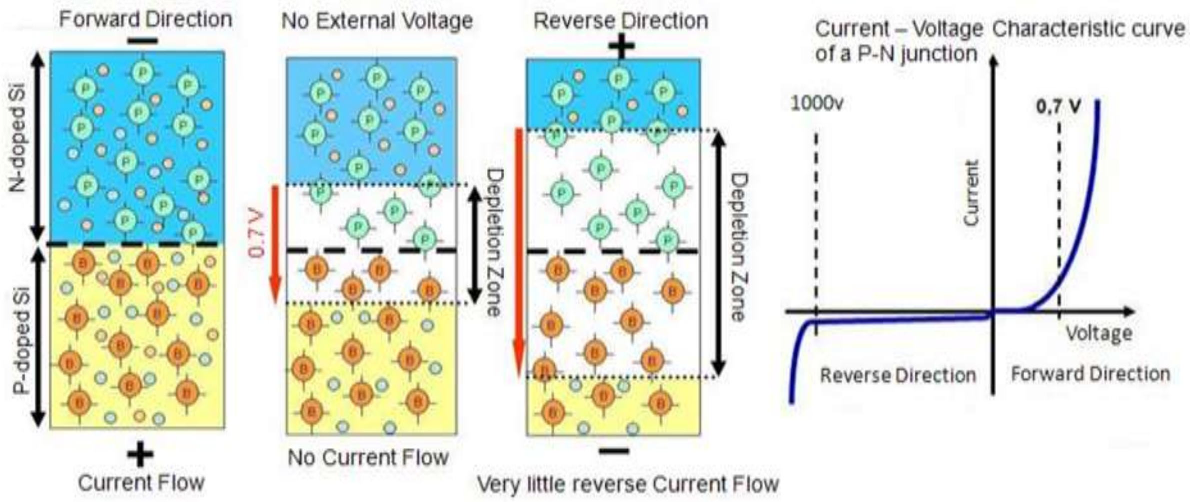

Fig 1 Functioning of solar cell

Silicon is a much known semiconductor having properties of both metals and non-metals. To make a solar panel, this silicon is doped by a pentavalent impurity converting silicon into positive type silicon also known as p-type silicon. And similarly other part is converted into negative or n-type silicon. As name suggest p-type have excess of holes (positive charge) in it and n- type has excessive electrons. Then these two are combined together one over other up to the atomic level. Due to their contact and having opposite charge electrons flow from n-type to p-type and holes travel from p-type to n-type thus creating a thin potential barrier between them. The current so generated from this movement of charges is named as diffusion current. But we need to understand yet another thing that is due to this potential barrier, giving rise to electric field which flows from the positive charge near n-type and negative charge near p-type junction (the area where potential is generated or meeting area of p and n type). Due to electric field electrons from p-type starts flowing towards n-type and holes from n-type towards p-type giving rise to a current called drift current. Initially the diffusion current is more than the drift current but as potential difference increases due to diffusion it simultaneously increases the drift current. Current stops flowing when drift current becomes equal to diffusion current.

Sunlight travels to earth in the form of small energy particles called photons. This photon strikes the p- type region and transfer its energy to hole and electron pair thus exciting the electron and it gets away from hole. The electric field we have due to potential difference at p-n junction makes its electron to travel to n-type region thus causing the current to flow.

But there a bit more to know, to make this electric field strong enough so that it must travel to n-type region and not recombine with the hole it has been separated from. To make this electric field strong the n-type and p-type regions are connected to negative and positive terminals of battery, this process is known as reverse bias condition. Doing this increases the probability of electron travelling all along the way to n-type region once separated from a hole. Thus increasing the efficiency of a solar panel.

1.3.2 Working Principle

The working principle is that we use the energy of photons to get the drift current flowing in the circuit using reversed bias p-n junction diode (p-type and n-type silicon combination).

1.3.3 Main Components

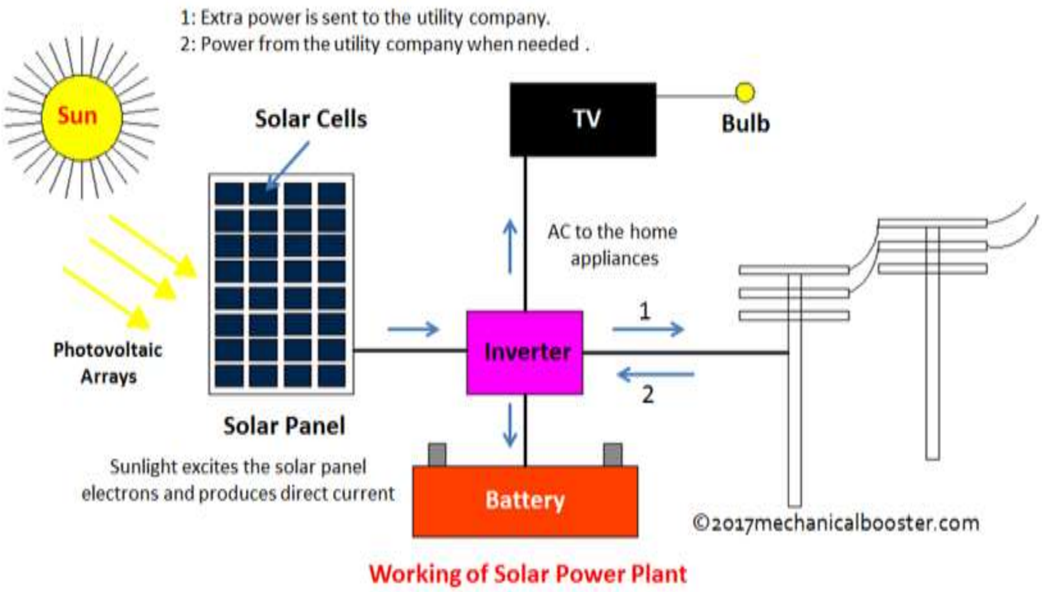

Fig 2. Working of solar power plant

1. Solar Panels

It is the heart of the solar power plant. Solar panel consists a number of solar cells. We have got around 35 solar cells in one panel. The energy produced by each solar cell is very small, but combining the energy of 35 of them we have got enough energy to charge a 12 V battery.

2. Solar Cells

It is the energy generating unit, made up of p-type and n-type silicon semiconductor. It's the heart of solar power plant.

3. Battery

Batteries are used to produce the power back or store the excess energy produced during day, to be supplied during night.

4. D.C. to A.C. Converter (Inverter)

Solar panels produce direct current which is required to be converted into alternating current to be supplied to homes or power grid.

1.3.4 Working of Solar Power Plant

As sunlight falls over a solar cell, a large number of photons strike the p-type region of silicon. Electron and hole pair will get separated after absorbing the energy of photon. The electron travels from p-type region to n-type region due to the action of electric field at p-n junction. Further the diode is reversed biased to increase this electric field. So this current starts flowing in the circuit for individual solar cell. We combine the current of all the solar cells of a solar panel, to get a significant output.

Solar power plant has a large number of solar panels connected to each other to get a large voltage output. The electrical energy coming from the combined effort of solar panels is stored in the Lithium ion batteries to be supplied at night time, when there is no sunlight.

1.4 How solar power can be upgraded?

1.4.1 Generating solar electricity at night.

Mirrors use energy from the sun when it's not shining.

Fig 3. Generation of Solar power in night

Planta Solar 10 is the world's first commercial concentrating solar power tower operating near Seville in Andalusia, Spain. So how does it work?

One of the biggest issues facing renewable energy has been generating power during periods of unfavorable weather or time of day. On a windless night, for instance, neither solar panels nor wind turbines can produce energy.

This is where solar power towers shine. They capture the sun's energy during the day and store it to be used after sundown.

If you've ever used a magnifying glass on a sunny day, you might have noticed that if you place it at just the right angle and distance from an object, it focuses light into an intense point.

This is essentially how a solar tower collects heat.

Thousands of moveable mirrors called heliostats on the ground are angled to reflect sunlight to a central receiver at the top of the tower.

That concentrated heat can turn water into steam to power a turbine – or, in newer models, be stored in a "hot tank" full of molten sodium or salts (such as a mix of potassium nitrate and sodium nitrate) sitting around 550 °C.

II. LITERATURE SURVEY

• T Wong Chin-Hong et al. [1] have studied the simulations of a vibration based piezoelectric raindrop energy harvester to investigate design parameters that directly affect the performance of the device. Combination of diaphragm and cantilevers is considered for the study and the device is simulated using Convertor Ware of multi physics finite element analysis. Polyvinylidene fluoride is used as piezoelectric material due to non-toxic characteristic and easiness to shape into sturdy panels, whereas aluminum as the electrode. The effects of design parameter such as thickness of piezoelectric material, displacement during vibration and maximum pressure applied on the performance of the device are analyzed. Results show that the thickness of these materials played a significant role in displacement and output power.

• A.R. Zainal et al. [2] have studied the satellites for television, telephone and data communication employ ever-increasing radio frequencies in order to satisfy the growing demand for communications. At frequencies above 10 GHz, the effects on radio propagation of clouds, snow and, in particular, rain have to be considered. Measured data, and models to predict the effect of rain on communication systems, are therefore required before establishing satellite communication systems

• Xue Zhao et al. [3] have reviewed Solar and wind energy harvesting technology is increasingly an economical and efficient energy form and receives excellent support from government policies worldwide. Various functional and structural nanogenerators based on multi-effects named hybridized nanogenerators have been reported separately or simultaneously to effectively generate the wasted mechanical and solar energy in our daily life. We review the development of hybridized nanogenerators, including the working mechanism of solar and mechanical energies.

• Kean Wong Jee et al. [3] have investigated when raindrops impact on the surface of a piezoelectric beam, strain energy produced by the impinging raindrop will be converted to harvestable electrical energy by the piezoelectric layers in a cantilever beam. The influences of rain parameters such as rain rate, rainfall depth, raindrop count, and drop size distribution(DSD) are discussed in this study. The raindrops accumulated on the surface of the piezoelectric beam will form a water layer. It is described using added mass coefficient in this study. In an actual rain experiment, a piezoelectric beam with surface area of 0.0018 m is able to produce 2076 μJ of energy over a duration of 301 min.

• M. Ericka et.al [5] have investigated the capability of harvesting the electric energy from mechanical vibrations in a dynamic environment through a uni-morph piezoelectric membrane transducer. Due to the impedance matrices connecting the efforts and flows of the membrane, we have established the dynamic electric equivalent circuit of the transducer. In a first study and in order to validate theoretical results, we performed experiments with a vibrating machine moving a macroscopic 25 mm diameter piezoelectric membrane. A power of 1.8mWwas generated at the resonance frequency (2.58 kHz) across a 56 k_ optimal resistor and for a 2 g acceleration.

• Tworkoski et al. [6] have studied Changes in hydrostatic pressure, at levels as low as 10 mm Hg, have been reported insome studies to alter cell function in vitro; however, other studies have found no detectable changes using similar methodologies. We here investigate the hypothesis that the rate of depressurization, rather than elevated hydrostatic pressure itself, may be responsible for these reported changes. Hydrostatic pressure (100 mm Hg above atmospheric pressure) was applied to bovine aortic endothelial cells (BAECs) and PC12 neuronal cells using pressurized gas for periods ranging from 3 hours to 9 days, and then the system was either slowly (~30 minutes) or rapidly (~5 seconds) depressurized. Cell viability, apoptosis, proliferation, and F-actin distribution were then assayed. Our results did not show significant differences between rapidly and slowly depressurized.

• Gangappa Kedarnath Ingalgi et al. [7] have researched similar to nano power generation using renewable energy have been explored. A variety of renewable energy has been prologue. This project is modified at economical level. One piezoelectric can be generate in average of 1.5 to 12 volts for each mechanical action. This research has been improved for the purpose of saving the energy. Rising demand leads to new inventions. This project has been analysis at that surface. Using one or more piezoelectric sensors are connected in series connection to get additive voltage to the output from the piezoelectric generation. The output is in the form of alternating current, by use of rectifier units which convert alternating current into direct current.

• Dr. L. Zheng et al. [8] have reported a hybridized power panel to generate electricity from solar, raindrops, and wind. By hybridizing a transparent dual-mode TENG with a common solar cell, the hybridized power panel can simultaneously/individually harvest solar, raindrop, and wind energy in various weather conditions around the clock. Without compromising the output performance of the original solar cell itself, the presented hybrid cell can, respectively, deliver an average output of 86 mW m −2 from the dripping water drops at a rate of 13.6 mL s −1, and an average output of 8 mW m −2 at a wind speed of 2.7 m s −1.

• Sudhakar N Hallu et al. [9] have studied the piezoelectric transformer is a combination of piezoelectric actuators as the primary side and piezoelectric transducers as the secondary side, both of which work in longitudinal or transverse vibration mode. These actuators and transducers are both made of piezoelectric elements, which are composed of electrode plates and piezoelectric ceramic materials. Instead of the magnetic field coupling between the primary and secondary windings in a conventional magnetic core transformer, piezoelectric transformers transfer electrical energy via electro-mechanical coupling that occurs between the primary and secondary piezoelectric elements for isolation and step-up or step-down voltage conversion.

• Kok Gnee CH et al. [10] have studied ecological source of renewable energy, the available kinetic energy of rainfall is not trifling, especially in tropical countries at the equators. Performance of different types of piezoelectric harvesters in terms of power output, area power density and energy conversion efficiency are compared. Summaries of key problems and suggestions on the optimization of the performance of the piezoelectric harvesters are also provided for future works.

• Energia, et al. [11] have reviewed this paper, an experimental comparison between different rainfall harvesting devices through the study of the electrical rectifying circuit is proposed. In more detail, three harvesting structures are considered: the cantilever, the bridge and the floating circle. Different waveforms were acquired and discussed. The processed data were compared in order to suggest the best choice for the rectifying circuit, from the simplest one to that most frequently endorsed in the technical literature.

• Norkharziana Mohd Nayana et al. [12] have researched was developed for the purpose of saving the energy. Rising standards and technological developments led to invention of new technology in everyday life. Nowadays, a variety of advanced technology has been introduced. Researches related to renewable energy nowadays have been extremely explored. The output from the piezoelectric produced alternating current (AC), then using rectifier circuit for convert to direct current (DC). This project also included a power bank for the power storage generated. Lithium ion battery is utilized in the circuit bank. 12 volts from the output can be generated electronic device basically in home application such as LED lamp and fan.

• Ciro Spataro, et al. [13] have reviewed this paper the performances of rainfall energy harvesting by means of piezoelectric transducers is presented. Diverse studies agree on the level of suitable generated voltage on the electrodes of a piezoelectric transducer subjected to rainfall, but a complete characterization on the supplied power is still missing. This work, in order to limit optimistic forecasts, takes into account the behavior of the transducers subjected to real and also artificial rainfall, condition that has shown promising behavior in laboratory.

• F. Viola et al. [14] have reviewed this paper a model to predict the harvest of the energy contained in rainfall by means of piezoelectric transducers is presented. Different studies agree on the level of suitable generated voltage on the electrodes of a piezoelectric transducer subjected to rainfall, but a complete characterization on the supplied power is still missing. This work, in order to limit optimistic forecasts, compares the behavior of the transducers subjected to real and artificial rainfall, a condition that has shown promising behavior in laboratory.

• JacksonW. et al. [15] have studied the harvesting power with a piezoelectric vibration powered generator using a full-wave rectifier conditioning circuit is experimentally compared for varying sinusoidal, random, and sine on random(SOR) input vibration scenarios; the implications of source vibration characteristics on harvester design are discussed.

• Springer Verlag et al. [16] have studied the piezoelectric effect and related electromechanical properties are described, and examples of modern piezoelectric materials and their sensitivity are considered. Full sets of electromechanical constants of various piezoelectric materials are given for comparison.

• Sandra Henderson et al. [17] have researched work forward, Wen and his colleagues want to explore ways to integrate this new kind of device into mobile and flexible devices, such as electronic clothes. However, Wen says the output power efficiency would need to be further improved before practical application can be realized.

• Li Zheng et al. [18] have studied the Silicon-based solar cell is by far the most established solar cell technology. The surface of a solar cell is usually covered by a layer of transparent material l to protect the device from environmental damages/corrosions. Here, were placed this protection layer by a transparent triboelectric nano generator (TENG), for simultaneously or individually harvesting so land raindrop energy when either or both of available in our living environment.

• O. V. Oyelade et al. [19] have reviewed this paper presents the results of a combined experimental and analytical/computational study of the effects of pressure on photo conversion efficiencies of perovskite solar cells (PSCs). First, an analytical model is used to predict the effects of pressure on interfacial contact in the multilayered structures of PSCs.

• IEEE et al. [20] have published the switching power conditioning techniques are known to greatly enhance the performance of linear piezoelectric energy harvesters subject to harmonic vibrations. With such circuits, little is known about the effect of mechanical stoppers that limit the motion or about waveforms other than harmonic vibrations.

• Zhau-Zi Ong Voon-Kean Wong Jee-Hou Ho et al. [21] have studied the piezoelectric beam to harvest vibration energy from the impact of raindrop is a feasible approach in renewable energy conversion. There are some prototypes developed in recent years to demonstrate this concept. Following our previous works on mathematical modelling and experimental investigation of water droplets on a piezoelectric beam, we propose a design modification to enhance the performance of a piezoelectric rain energy harvester.

• Dr. SubratSahu et al. [22] have studied there has been significant research on solar energy technologies in recent years. It is observed that very little has come out of this research in terms of commercially interesting solar energy technologies. The long term perceived potential of solar energy is the key driver for technology innovation in solar industry.

• Ramsundar Sivasubramanian et al. [23] have studied the increasing prevalence and miniaturization of electronic devices has driven global efforts to develop small scale, self-sustaining, rugged and ecologically viable power sources.

• Nalini Dasari1 et al. [24] have reviewed this paper, a literature review on flat-plate solar air heater having different obstacles on absorber plates has been highlighted. The thermodynamic analysis of solar air heaters with single pass, double pass, different obstacles on absorber plate and comparisons which was done among them by different researchers is reviewed in this paper. Further, the energy analysis and energy analysis of solar air heaters have been discussed too.

• Shahab Mehraeen, Jagannathan Sarangapani al. [25] have studied the piezoelectric transducers are increasingly being used to harvest energy from environmental vibrations in order to either power remote sensors or charge batteries that power the sensors. beam is conducted by using a dozer for earth-moving applications, and experimental results are discussed.

IV. MATERIALS / METHODOLOGY

The following chapter deals with material and methodology used for the project

4.1 Materials

4.1.1 Working of Solar Panel

- Solar panel works by absorbing sunlight with photovoltaic cells, generating alternating current (AC) energy and then converting it to usable direct current (DC) energy with the help of invert technology.

Fig 4. solar panel

- Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect.
- Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer.
- Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available.

Fig 5. Solar set up of a house

- The cells are connected electrically in series, to one another to get the desired voltage and then in parallel to increase amperage. The wattage of the module is the mathematical product of the voltage and the amperage of the module.
- The manufacture specifications on solar panels are obtained under standard condition which is not the real operating condition the solar panels are exposed to on the installation site
- A PV junction box is attached to the back of the solar panel and functions as its output interface. External connections for most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. A USB power interface can also be used.

4.2 Working of Piezoelectric Sensors

4.2.1 Working Principle

When a force is applied on a piezoelectric material, an electric charge is generated across the faces of the crystal. This can be measured as a voltage proportional to the pressure (see the diagram below).

Fig 6. working of piezoelectric sensor

- There is also an inverse piezoelectric effect where applying a voltage to the material will cause it to change shape.
- A given static force results in a corresponding charge across the sensor.
- Piezoelectric sensors are not normally suitable for measuring static pressure. The output signal will gradually drop to zero, even in the presence of constant pressure.
- They are, however, sensitive to dynamic changes in pressure across a wide range of frequencies and pressures and are good at measuring small changes in pressure, even in a very high-pressure environment.

Fig 7. piezoelectric sensor

4.2.2 Function

Unlike piezo resistive and capacitive transducers, piezoelectric sensor elements require no external voltage or current source. They generate an output signal directly from the applied strain.

The output from the piezoelectric element is a charge proportional to pressure. This requires a charge amplifier to convert the signal to a voltage. The presence of the electronic components does, however, limit the operating temperature to not much more than 120ºC. For higher temperature environments, a charge-mode sensor can be used. This provides the generated charge directly as the output signal. It therefore requires an external charge amplifier to convert this to a voltage. Care is required in the design and implementation of the external electronics. The high impedance output of the sensor means the circuit is sensitive to noise caused by poor connections, cable movement, electromagnetic and RF interference.

4.2.3 Construction:

The piezoelectric effect requires materials with a specific asymmetry in the crystal structure. This includes some natural crystals, such as quartz or tourmaline. In addition, specially formulated ceramics can be created with a suitable polarization to make them piezoelectric. These ceramics have higher sensitivities than natural crystals.

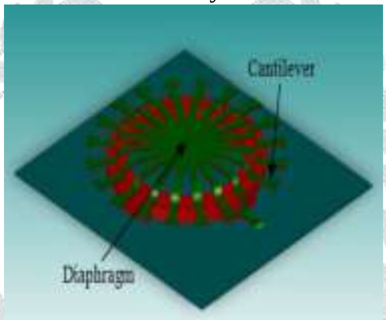

Fig 8. section of piezoelectric sensor

A useful output can be generated with as little as 0.1% deformation. Because the piezoelectric materials are rigid, only a very small deflection of the material is required to get a usable output signal.

This makes the sensors very robust and tolerant of over-pressure conditions. Micro-sensors can be constructed using thin films. Zinc oxide was one of the first materials used. This has largely been replaced by ceramics made from materials such as lead zincronate titanate (PZT) because of their larger piezoelectric effect.

Working of rectifier:

Rectifier is a device that converts an oscillating two-directional alternating current (AC) into a single-directional direct current (DC). The reverse operation is performed by the inverter. The process is known as rectification, since it "straightens" the direction of current.

4.3 Soldering

It is a process in which two or more items are joined together by melting and putting a filler metal into the joint, the filler metal having a lower melting point than the adjoining metal.

4.4 Frame Details

A rectangular frame is made with wood. All the borders of the wooden rectangular frame are drilled with 6mm bit.

Each border consists of 4 L shaped cavities, through which wires are connected to the sensors.

4.4.1 3-D View

Fig:9. 3D view of Frame.

4.5 Methodology

The following flow chart shows the methodology used for the project.

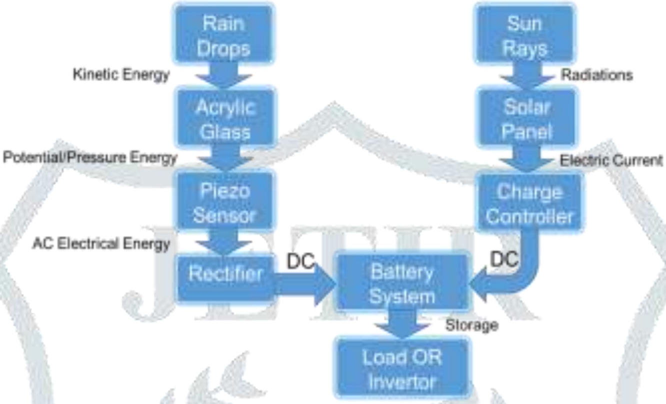

Fig 10. flow chart of working of system

- Acrylic glass sheet is placed on the piezo sensors which converts the kinetic energy of the rain drops into pressure energy and distribute pressure energy to all the piezo transducer.
- Nano power generations from rain drops and solar regarding this concept we can increase the efficiency of solar power production system.
- Piezoelectric sensors should be mounted on the outer periphery of the solar panels.
- The output of piezo will be in the form of alternating current (AC).
- The AC output in given to the rectifier and filter circuit which converts alternating piezo into direct current (DC).
- The final output of the battery is given to the batteries which in there is stored as charges which can later be used for other applications.

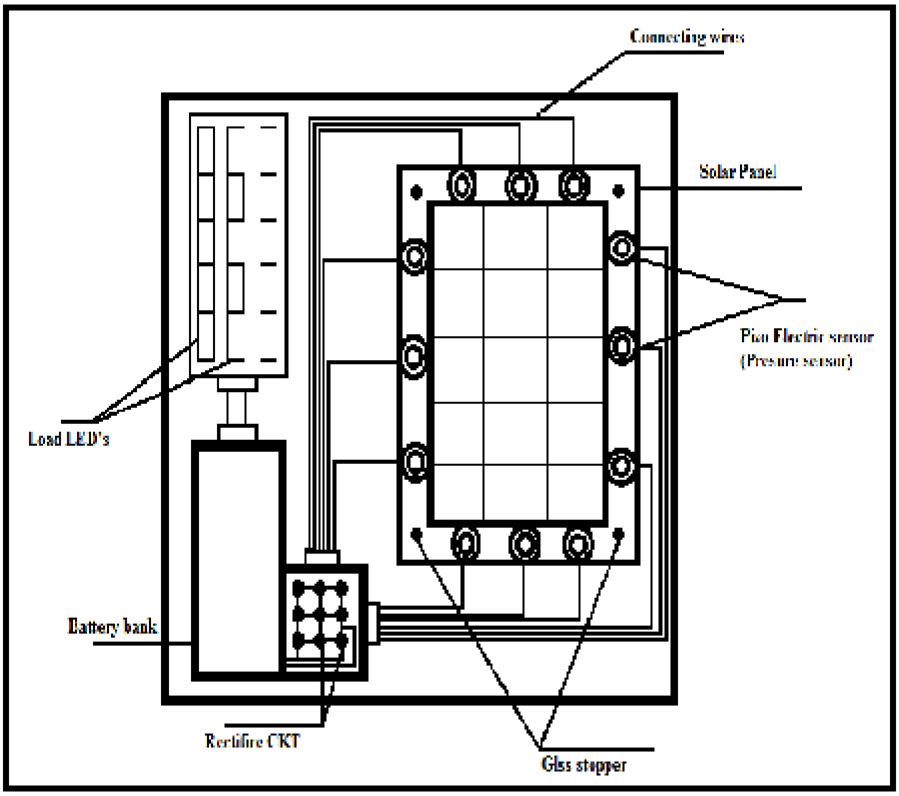

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Fig:11. System Setup

V. RESULTS AND DISCUSSION

5.1 In this chapter results and discussion on the performance of the cell is justified. Experiment shows that how Solar panel can be modified and increased in efficiency to work in various weather conditions.

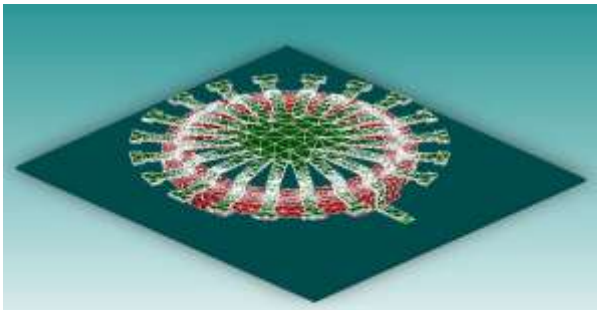
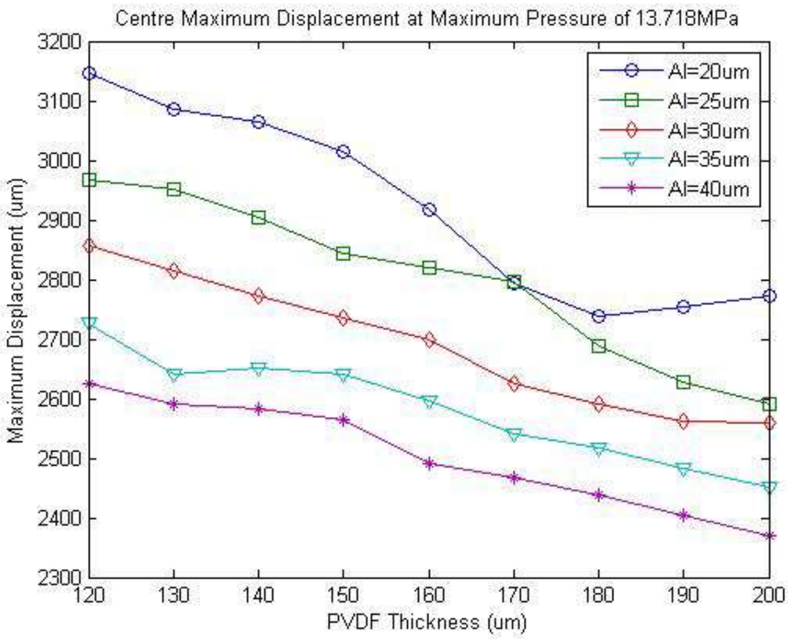


Fig:12. Meshed model of piezoelectric raindrop energy harvester

Vibration occurs as raindrop impact on the surface of piezoelectric structure. The raindrop impact pressure is determined the displacement of vibration on diaphragm and cantilevers. In order to obtain the impact pressure, raindrop fall velocity and its diameter have to be identified. Based on the data collect, the diameter of raindrop is ranging from 0.1mm – 5.8 mm and its drop velocity from 0.27 – 9.17 ms-1. shows the relationship between droplet diameter and its fall velocity. The impact pressure can be calculated with the following equation: P □ ρ Cv



[1]

Fig:13. Maximum displacements for center of diaphragm with maximum raindrop impact pressure of 13.718 MPa.

5.2 Discussion

- Whole system of Solar and Rain Pressure Cell performs well under uniform rain volume as compared to uneven rain velocity.
- The Solar panel works up to 99.95% of its capacity under the influence of Acrylic glass sheet.
- The system will give favorable results as expected from a hybrid Solar and Rain Pressure Cell

VI Conclusion

The FEA simulation analysis to study the performance of raindrop energy harvester due to design parameters is performed successfully. The selected thickness for upper and lower electrode is 30 μm whereas the PVDF thickness of 160 μm is chosen for piezoelectric raindrop energy harvester. These thickness are able to support the impact pressure of largest droplet which is 13.718 MPa and without exceeded the maximum displacement limit which is 2800 μm. It generates a displacement of 2683.11 μm for cantilever and 2698.17 μm for center diaphragm as largest raindrop impact on it. [1]

This paper has focused on the power generation by using solar and rain drops. This paper is mainly aims that to get better efficiency of the solar in the rainy season we can use pressure sensors to convert kinetic energy of the rain drops into the electrical energy. By aliened arrangement of pressure sensors we improve efficiency of solar panel. This type of arrangement is also help full for the rain forest area. The final output of rectifier is given to battery which store the charges produced and those charges are utilized for various applications. This paper mainly aims to use renewable energy to overcome the problems related to the solar energy. [7]

Piezoelectric nanogenerators rely upon the phenomenon of piezoelectricity to convert mechanical stresses into electric potential. This phenomenon is exhibited by certain materials such as quartz, ZnO (Wurtzite), PZT (Perovskite), BaTiO and PVDF. In an unstressed state, the charge centers of the cations and anions in a piezoelectric material coincide with each other and the material remains electrically neutral. When a mechanical stress is developed due to external force the material. [23]

VII Scope for Future Work

Further work regarding this project can be done to improvise the rain water to be carried to the cells in manner of levels with respect floors of a building. This may include assembly of multiple cells arranged in a manner so that volume of rain water should flow in a particular stream to increase the output of the cell assembly. Increase in area of piezoelectric sensors could result in output of the cell efficiency.

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