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Energy Scavenging Artificial Tree

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ABSTRACT: Renewable energy sources are the reliable sources which doesn't produce any greenhouse gases or doesn't affect the environment, but non-renewable sources are non-eco-friendly. So in order to generate the electrical energy in an eco-friendly manner we have to switch over to renewable sources. In this concept wind energy and solar energy is used to generate the electricity with the help of Nano leaves. Several nano leaves are placed in the form of tree, called Solar Botanic tree. A Nano leaf consists of Nantenna, TPV and Piezo cell in order to generate electricity. The power generated from the Nano leaf is environmental friendly, and this tree can be installed at different locations.

KEYWORDS: Nanoleaf, Nantenna, TPV cell

I. INTRODUCTION

Mainly there are two sources available by which electricity can be generated, they are Renewable and non-renewable sources. Non-renewable sources are Coal, fuel etc. which are not abundantly available i.e. they may exhaust in the future but by using the renewable sources electricity can be generated continuously as these sources are continuously available. So in this concept the renewable sources like solar energy and the wind energy is utilized in order to generate the electricity.

Energy harvesting is a process of capturing the small amounts of energy that would otherwise be lost as heat, light, sound, vibration or movement. Natural energies like Solar and Wind are the renewable sources, which emerged as future electricity source due to limited fossil fuel. The environmental energy is harnessed and converted into electrical energy, and hence these are environmental friendly. The examples for such energy sources are heat energy, light energy, sound energy, electromagnetic wave etc.

In the future there may exists the scarcity of energy sources as non-renewable sources are extinguishing, but this technology makes use of renewable sources which lasts for millions of years and will be helpful for future.

II. LITERATURE SURVEY

Traditional solar cells only use up to 20% of the visible light they collect, and more efficient solar cells are too expensive for mass production. While traditional solar cells only use visible light, the nantenna's use mid-infrared rays. This means that they can still collect energy after dark. Solar based energy harvesting research has long been an interesting and vital solution to the world's energy needs. Silicon based photovoltaic (PV) cells are very efficient and most common existing technology for solar cells; however it cannot be used to capture the entire electromagnetic (EM) radiation spectrum. To overcome these shortcomings, here we are exploring the new concept of nano-antenna solar cells instead of conventional PV cells. [2]

A nantenna has the possibility to absorb entire electromagnetic radiations with efficiency of 85% and low manufacturing cost.

Traditional solar cells depend on the band gap energy of N-type (majority charge carriers of electrons) and P-type semiconductor (majority charge carrier of holes) and antireflection coating (Transparent conducting oxide (TCO)). But average single and multi-layer solar cell efficiency is not more than 50% as it cannot use entire solar spectrum (infrared to visible), hence it limits the efficiency of solar cell because the entire spectrum of sunlight, from infrared to Also, lack of perfect anti-reflecting coating due to maximum amount of light reflected from or transmitted through it, which leads to energy loss. the reduction in efficiency of solar cell due to transmission results in energy loss and in substrate heating because of an anti-reflecting coating cannot prevent transmission of light through a thin PV layer.[3]

Major draw backs of traditional solar cells are due to many factors such as

a) Today's even the best silicon solar panels collect only about 20 per cent of available solar radiation
b) Separate mechanisms are needed for conversion of stored energy to electricity

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c) Solar panels, made up of many and/or huge number of cells
d) There are expensive to manufacture and develop
e) Operate at high temperatures
f) Expensive production costs
g) Limited efficiency and
h) Operate only at visible light wavelength, rendering them idle after dark
A nantenna is a fascinating technology being developed for alternative to PV cells for conversion of An overview of this paper explored the possibility of utilizing a flexible nantenna for solar cell applications. Nantenna's with futuristic size and shape, which could harvest more energy from a wider spectrum of sunlight, then is currently achieved. Nantenna could be a more efficient and cost effective than PV cells for green energy venture in the near future.

III. SOLAR BOTANIC TREE

Solar botanic tree utilizes the nano-technology which was initially developed to harness the solar energy and it utilizes various alternative sources of energy like wind, solar and thermal energy. Furthermore, these artificial trees use tiny cells to capture energy.
Several nano leaves are placed to form a solar botanic tree, and the main part of the solar botanic tree is Nano leaf.

Fig. 3.1 Solar Botanic Tree

IV. NANOLEAF

In order to construct the nano leaves we need Nantenna, thermo voltaic cell, piezo voltaic cell. The construction of nano leaves is very easy. It consists of two transparent conducting layers of silica which will act as the outer body of the leaf. And one Nantenna is placed in between these two layers which are used to convert the light energy into electrical energy then the pieozovoltaic cell, thermo voltaic cell and Nantenna are used. All these cells are interconnected to the highly conducted metal film to complete the circuit for the flow of electrons and protons. The piezoelectric generator is placed on the bottom of the leaf which is used to convert the stress due to rain and wind into the electrical energy. Now these leaves are connected to the twigs of the artificial tree. And these small twigs are connected to the stem of the tree with the means of the piezoelectric crystal to covert the stress of the twig also into electrical energy. The electrical energy from all the leaves and twigs is stored at the bottom of the tree by using the storing device. And the solar botanic tree is about 20 feet height.

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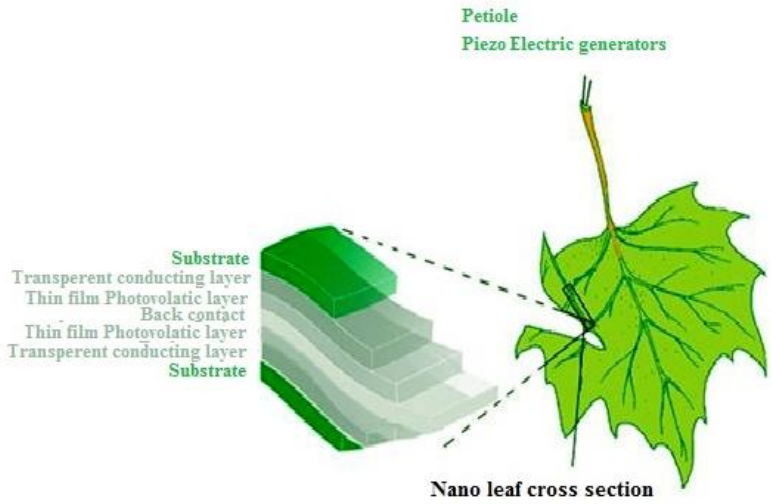
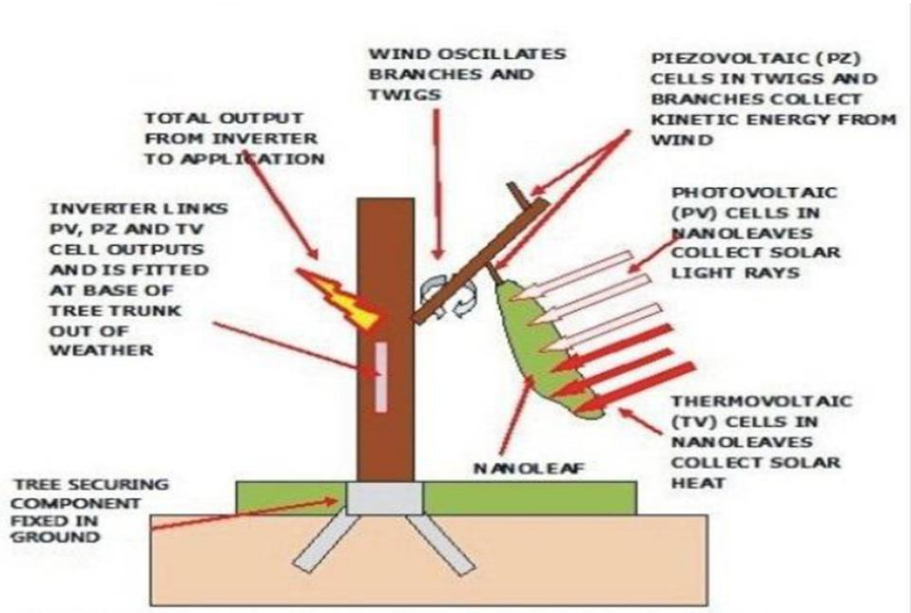


Fig 4.1 Cross section of Nano leaf

V. CONSTRUCTION

As the name indicates, it is having tree shaped structure. It's about 20 feet height and 6 meter in diameter. The trunk and twigs are made of polymers and synthetic resin. The main part of this tree is nano leaf, which consists of two cells i.e. nantenna cell and TPV cell. The leaf consists of two layers one is positive layer and negative layer. In between these layers nantenna and TPV cells are interfaced. The battery and inverter are placed in trunk to which load is connected.



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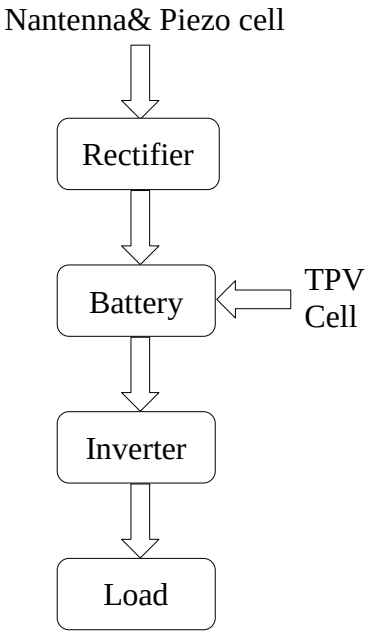
VI. BLOCK DIAGRAM



VII. WORKING

It works on the principle of bio-mimicry. Bio-mimicry is a process done by natural trees i.e. capturing sun energy and converting that energy into another form of energy by photosynthesis process. In this concept sun energy as well as wind energy is used to convert the natural form of energy into electrical energy by using nantenna, TPV cell and PZ cell.

A. Sun energy

Sun energy includes visible and invisible light rays, by using both of these light rays electrical energy is generated.

- **Light energy**

The light energy is converted into electrical energy by nantennas. When the visible light ray falls on the nano leaf, the nano-antenna absorbs that light energy and the electrons in the nantenna moves back and forth at the same frequency as the incoming light. This movement of electrons causes an alternating current (AC) in the nantenna circuit. To convert this into direct current (DC), the Ac must be rectified, which is typically done with some kind of diode. The resulting Dc current can then be used to power an external load.

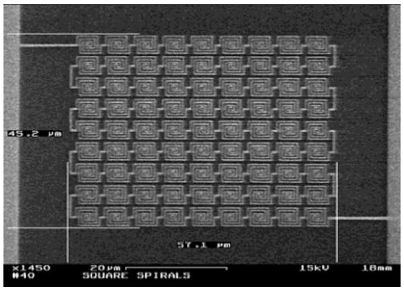


Fig. 7.1Nantenna

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- **Thermal energy**

Sun light includes visible light rays and invisible light rays, invisible light rays are nothing but the heat energy. And in this artificial tree these invisible rays i.e. when heat energy falls on the nanoleaf the thermo voltaic cell converts heat energy into electrical energy.

These cell works on the principle of seebeck effect. The seebeck effect is the conversion of heat directly into electricity at the junction of different types of wires. And it states that "Temperature difference between two dissimilar electrical conductors or semiconductors produces a voltage difference between two substances". As there is a temperature difference between two sides of a chip the electrons will flow in silicon nano-wire, this causes generation of electricity which is in DC form, this DC is stored in a battery.

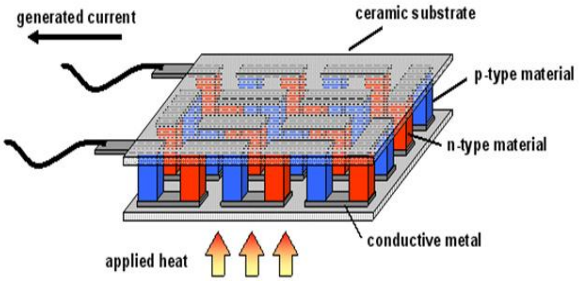

Fig. 7.2 TPV Cell

B. Wind energy

The wind energy is converted into electrical energy by using the piezo electric cells. Piezo electric cell generates the electricity when the stress or vibration is applied on it. Piezo cell is nothing but a crystal which becomes a kind of battery with positive charge on the face and negative charge on the opposite face, when the two faces are connected to make a circuit the current will flow.

When the kinetic energy is applied on the nano leaf, the leaf moves up and down and the stress is applied on the leaf this stress is sensed by the piezo electric cell. Now the piezo electric cell converts the stress into electrical energy. The resulting current will be AC, this AC is converted into DC by using rectifier and is stored in battery.

The energy stored in the battery is given to the load by converting stored DC into AC with an inverter.

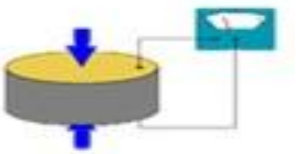

Fig. 7.3 Piezo Cell

VIII. ADVANTAGES

1. Maintenance is easy.
2. Pollution free.
3. Sources are freely available.
4. Production cost is less.
5. Not hazardous to health.

IX. DISADVANTAGES

1. Initial cost is high.
2. Complexity placing inverter.
3. Difficult to interface nantenna.

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X. APPLICATIONS

- Urban and rural area
- Recreational Parks and city parks
- Highways
- Airports
- Deserts
- Golf courses and resorts
- New housing estates

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