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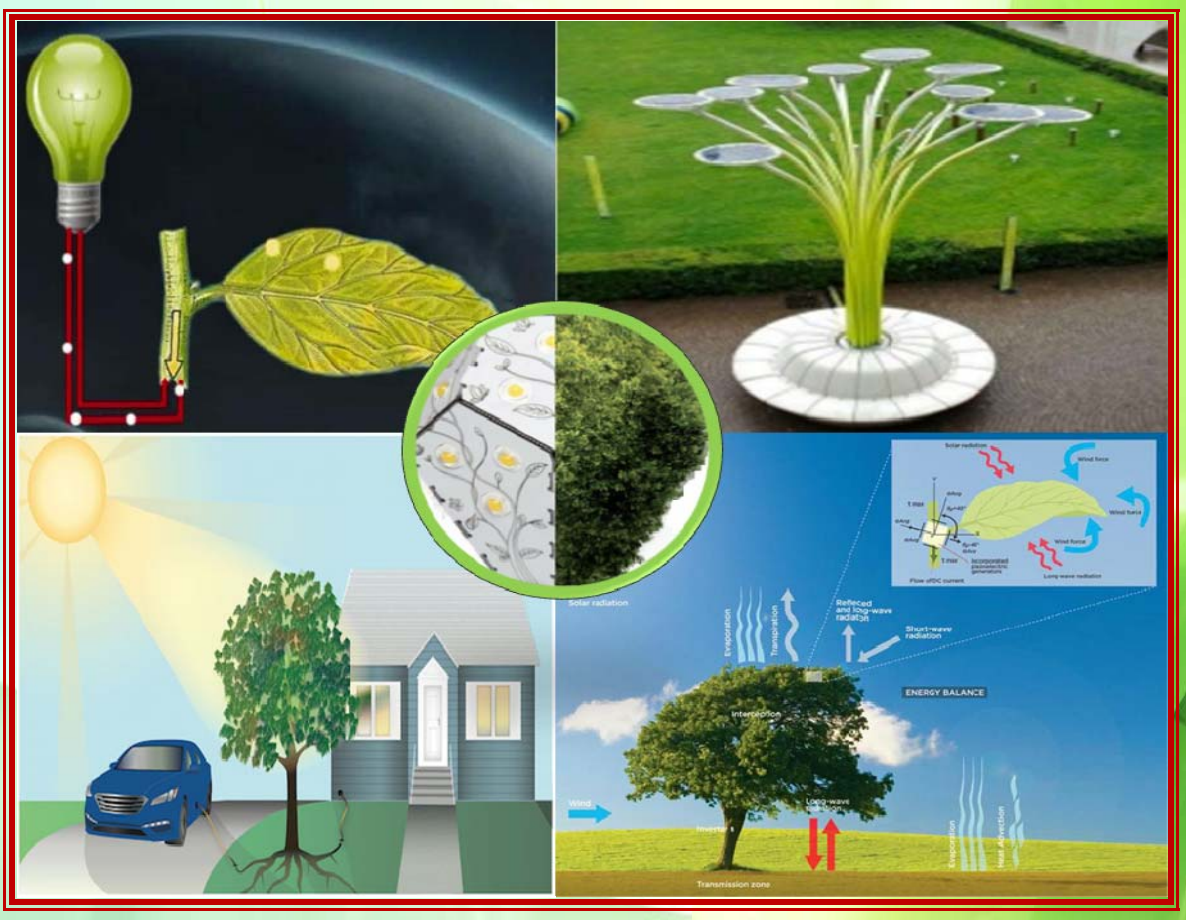
NANO TREE FOR NOVEL ENERGY HARVESTING TECHNOLOGY



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ENVIS Newsletter on Environmental Biotechnology is a half-yearly publication publishes articles related to the thematic area of the ENVIS Centre. Popular or easily intelligible expositions of new or recent developments are welcome.
Manuscripts should be typewritten (font should be Times New Roman and font size ought to be 12) on one side of the paper in double spacing with maximum of 6-8 typed pages.
Figures and typed table should be in separate pages and provided with title and serial numbers. The exact position for the placement of the figures and tables should be marked in the manuscript.

Articles should be sent to

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EDITORIAL

Nano tree is an artificial tree which makes use of renewable energy from sun, wind and collecting solar and wind energy. Biomimicry is a developing science attempting to solve human difficulties by adapting and implementing nature's systems to human technology. This is possible by the use of nature design with synthetic trees, shrubs, plants and flowers.

Energy harvesting trees are super eco-friendly synthetic trees will make use of renewable energy from the sun along with wind power, which are an effective clean and environmentally sound medium of gathering solar radiation and wind energy. It utilises three different energy generation technologies such as photovoltaic, thermoelectric and piezoelectric. Leaves are distributed through out artificial trees and plants and can supply entire household with maximum efficiency. It is cost efficient and attractive looking and providing the electric power.

In this newsletter (Vol. no. 27), we have attempted to discuss the **Nano Tree for Novel Energy Harvesting Technology** related issues.

(S. C. Santra)

IN THIS ISSUE:

INTRODUCTION

Energy harvesting is defined as capturing minute amounts of energy from one or more of the surrounding energy sources, accumulating them and storing them for later use. Energy harvesting is also called as power harvesting or energy scavenging. With recent advances on wireless and micro-electromechanical systems (MEMS) technology, energy harvesting is highlighted as the alternatives of the conventional battery. In the view point of energy conversion, human beings have already used energy harvesting technology in the form of windmill, watermill, geothermal and solar energy. The energy came from natural sources, called renewable energy, is emerged as future power source due to limited fossil fuel and nuclear power instability such as Fukusima nuclear crisis. Since the renewable energy harvesting plants generate kW or MW level power, it is called macro energy harvesting technology. On the contrast, micro energy harvesting technology is focused on the alternatives of the conventional battery. Micro energy harvesting technology is based on mechanical vibration, mechanical stress and strain, thermal energy from furnace, heaters and friction sources, sun light or room light, human body, chemical or biological sources, which can generate mW or μW level power (Fig. 1).

Source: http://www.fujitsu.com
Figure: 1 Overview of energy harvesting

Energy harvestiong as an alternative technique that has been applied to solved the problem of finite node lifetime and it refers to harnessing of energy from the environment or other energy sources for converting it to electrical energy. In this process the energy is collected from the environment. Examples of such energy sources include light, thermal gradients, vibrations, electromagnetic wave, etc. Harvesting energy from the surrounding environment is of growing interest to the research community, but in practice, design challenges limits its viability and ability to penetrate the market.

In the world where there will be scarcity for non-renewable energy sources, but mankind is blessed that we are provided with the solar power and wind power which will last for millions of years. By using this new technology, we can harvest the energy of the sun and wind by embodying substantiated science. Also existing source of renewable energy, solar panels, parabolic sun collectors, wind and tidal turbines are inefficient, expensive and environmentally insensitive. One of the emerging nanotechnologies related to renewable energy is nanoleaves and stems of artificially created trees or plants. They are an emerging form of renewable energy through collecting energy from the sun and wind and converting it to electrical energy. The leaves are distributed throughout artificial trees and plants, and when operating at optimum efficiency can supply a whole household with electricity. They are intended to harness energy provided by the wind and sun, thereafter converting it into electrical energy (Fig.2)

Nanoscience and nanotechnology suggest new ways to solve the performance/cost tradeoff that has limited large-scale commercial applications of solar energy conversion devices. Chemically synthesized nanocrystals, nanowires, nanorods, nanotubes, and a variety of other nanostructures offer new opportunities for solar energy conversion that promise lower fabrication cost and higher conversion

efficiency. As a result, there has been intensive research worldwide directed at taking advantage of nanomaterials to improve the applications of solar energy conversion.

Source: http://www.ifet.ac.in/
Figure: 2 Energy releasing from tree

USE OF NANO TECHNOLOGY

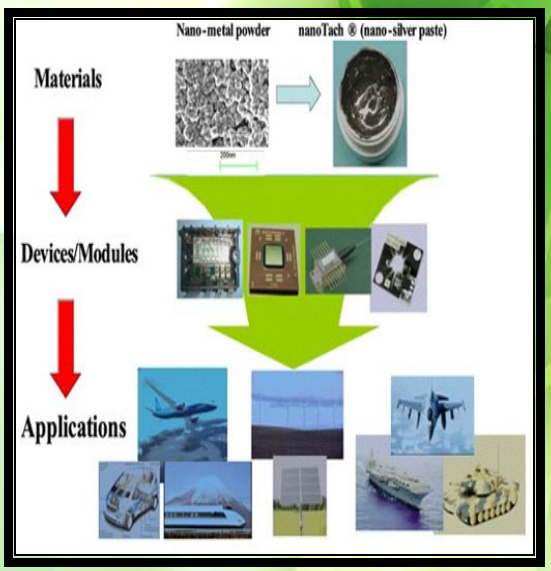
Nanotechnology is the combination of science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers at the nano-scale (roughly 1-100 nanometers. It is the engineering of functional systems at the molecular scale. The science of the miniature nanotechnology, though a relatively new field is fast emerging as the 'favourite of all' kind of technological arena due to its application in almost every field, from medicine to fabrics. 'Nano' in Greek means dwarf and material, when reduced to nano dimension (10^{-9}metre =1 nanometre) shows drastic changes in physical, chemical, magnetic, optical, mechanical and electrical properties. This promises exiting applications in bioscience, medical science, polymers sector, environment, electronics, cosmetics, security and variety of other fields.

Nanotechnology is a molecular manufacturing or more simply building things the size of one atom or molecule with programmed precision. It is a fascinating science as it offers many challenges to the scientists. One such challenge involves nano-leaves and nano-trees; These were once thought to be a fantasy, but have come into reality now.

Development of devices modified by nano-sized materials has become a fundamental goal of modern nanotechnology. By the use of nanostructured materials, some miniature devices could be fabricated in much smaller size while keeping higher performance.

In the last decade nanotechnology became one of the high priority areas of funding in advanced as well as emerging economies primarily due to the 'promise' this technology demonstrated; of providing solutions in high technologies and also possibility of new pathways for mitigating pressing developmental issues

Enormous energy efficiency by virtue of tiny size and enormous surface area per unit mass, enables nanoparticles to transform and revolutionize various fields of technology including aerospace, aviation, homeland security, national defense, energy, environmental improvement, information technology, medicine, transportation, biotechnology, agriculture etc. The commonly used nanoparticles are $nSiO_2$, $nTiO_2$, $nZnO_2$, CuO_2 (Fig. 3) .



Source: http://www.nbetech.com/
Figure:3 Various application of Nanotechnology

In recent years, nanotechnology research is emerging as cutting-edge technology interdisciplinary with physics, chemistry, biology, material science and medicine. Progress in the field of nanotechnology has been rapid and with the development of innovative synthesis protocols and characterization techniques Biogenic synthesis of nanoparticles with controlled morphology needs more attention, as the biogenic synthesis of nanoparticles is carried out by using biological means like bacteria , actinomycetes, lichens and algae. Hence, a number of researchers are focusing toward the synthesis of biogenic nanoparticles compared with the chemically or physically synthesized nanoparticles .

NANO PARTICLES FROM MICROBES

Microbes are the microscopic organisms which are single or multicellular found in all places. They include the bacteria, algae, fungi and protozoa. Microbes play an important role in balancing the ecosystem by various processes like biodegradation, sewage treatment, soil fertility and improving agricultural productivity. They produces several hydrolytic enzymes like Amylases, proteases, Lactase, Pectinases, Catalase, Penicillinase, Glucosidases etc. Mycotoxins like Aflatoxin, Zearalenone, Ochratoxin, Citrinin, T-2 toxin, Fumonisins etc. Pigments like qunonine, phenolic group, and also synthesizes the nanoparticles like Silver(Ag), Gold(Au), Platinum(Pt), Copper(Cu) (Table-1).

Out of the all microbes fungi are most effective candidate in synthesis of metal nanoparticles in large scale production. Because fungi secrete large amount of proteins and enzymes for reducing the metal ion and increasing productivity, large amount of biomass production and fungi have very high wall binding capacity. Nanoparticles synthesis from fungi known as myconanotechnology which has great demand. Due to their monodispersity fungi are bionanofactories of various metal nanoparticles like Ag, Au, Pt, Cd. Nanoparticles production source is intracellular or extracellular which depend on the reduction enzyme present in it. Silver, gold and copper nanoparticles are present in *Aspergillus niger, Fusarium oxysporum, Helminthosporium tetramera, Macrophomina phaseolina, Trichoderma harzianum* and *Trichoderma asperllum* (Fig.4).

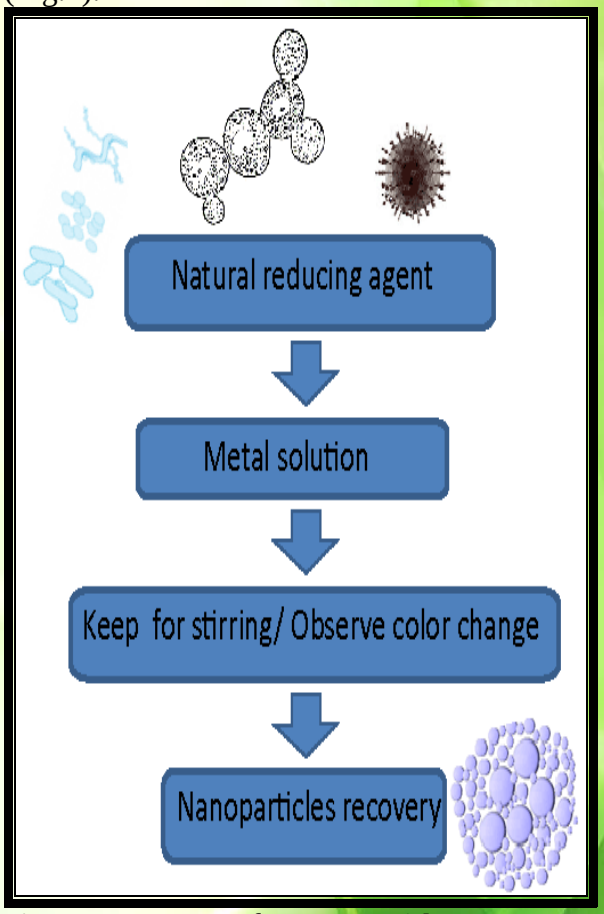


Figure: 4 Process of Nano particle recovery from Microbes

Table - 1 Nanoparticles from microbes

Name of the Microbes	Name of the nanoparticles
Bacteria	
Bacillus cereus	Ag 5
Bacillus thuringiensis	Ag 10/20 J
Escherichia coli	Ag 30/50
Escherichia coli	Cds---
Lactobacillus sp.	Ag, Au 15/40
Pseudomonas stutzeri	Ag>200
Corynebacterium	Ag 5/15
Staphylococcus aureus	Ag 150/180
Ureibacillus thermosphaericus	Ag 1/100

Fungi	
Aspergillus niger	Ag 20
Aspergillus oryzae	Ag 5-50
Fusarium oxysporum	Ag 1/5
Fusarium solani	Ag 5/35
Pleurotus sajor-caju	Ag 5/50
Trichoderma viride	Ag 10/40
Klebsiella pneumoniae	Se 100/400
Yeast	
Silver-tolerant strain	MKY3 Ag 2/20
Candida glabrata	CdS 50/150
Schizosaccharomyce pombe	CdS 50/150
Extremophillic yeast	Ag
Rhodospiridium dibovatum	PbS

Source: Pantidos and Horsfall, 2014. J Nanomed Nanotechnol 5: 233.

NANO TREE

It is an artificial tree which makes use of renewable energy from sun, wind and collecting solar and wind energy. Generally artificial trees cannot carry out photosynthesis naturally.

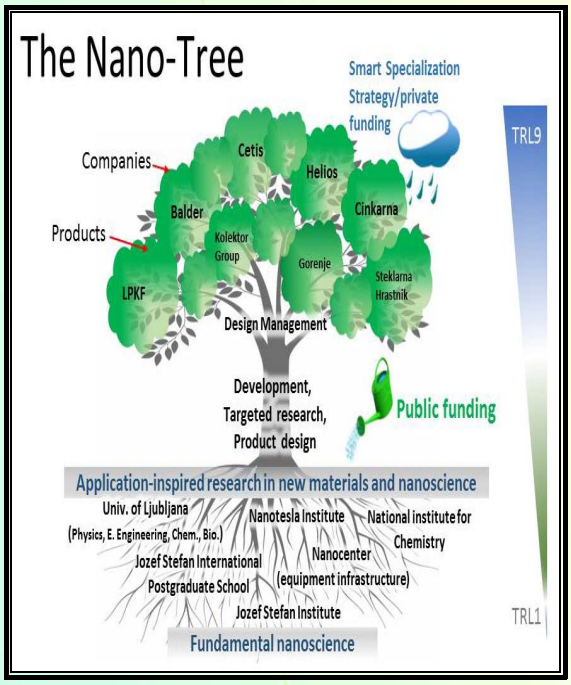
To reduce the use of fossil-based energy and substituting the same with renewable sources such as solar and wind energy etc. The artificial tree will produce the electrical energy by using both (wind as well as solar) energies (Fig. 5).

Source: http://solarbotanic.com/
Figure: 5 A single Energy Tree has the ability to completely power a three-bedroom home

Energy harvesting refers to scavenging energy or converting energy from one form to the other. Applied to sensor nodes, energy from external sources can be harvested to power the nodes and in turn, increase their lifetime and capability. A widespread and popular technique of energy harvesting is converting solar energy to electrical energy. Solar energy is uncontrollable—the intensity of direct sunlight cannot be controlled—but it is a predictable energy source with daily and seasonal patterns. Other techniques of energy harvesting convert mechanical energy or wind energy to electrical energy.

The synthesis of semiconductor nanowires is currently a very active field producing a large variety of results and potential technological applications. Controlled growth of branched nanotree structures by sequential seeding of multiple generations of nanowires has also been reported recently, introducing many new opportunities for the application of nanowire structures.

A photoelectrochemical cell (PEC) utilizes solar energy to directly split water and generate hydrogen, which is clean and free of carbon emission. However, it is broadly recognized by the PEC community that there is no single material that can be the perfect photoelectrode candidate for solar water splitting with respect to light absorption, water reduction, chemical stability, etc. The high efficiency "nanotree" photoelectrode research enables practical H_2 production or Volatile organic compounds (VOCs) remediation using PEC with high efficiency by using earth abundant materials and low-cost fabrication. This will have long-term, on-going, positive impact on the most imminent energy and environmental issues - clean energy and energy sustainability, environmental remediation, and therefore, have great benefits to our humanity today and tomorrow (Fig.6).



Source: http://www.nanocenter.si/
Figure: 6 Nano Tree

There are mainly two important reasons for which we should go for nano trees. They are as follows:

(i) This energy harvesting trees are ecofriendly and neat form of technology.

(ii) These solar trees could offer frequent plug- in stations for the electric vehicles and hybrids of the near and distant future.

One of the emerging nanotechnologies related to renewable energy is nano leaves and stems of artificially created trees or plants. They are intended to harness energy provided by the wind and sun, thereafter converting it into electrical energy moreover, to better understand the fundamental of nano leaves, we have to dig into an innovative field of technologic development, called biomimicry

BIOMIMICRY CONCEPT IN NANOTREES

Based on an innovative field of technologic development, called biomimicry. Biomimicry is a developing science attempting to solve human difficulties by adapting and implementing nature's systems to human technology. Biomimicry and Nanoleaf technology are intrinsic to each other.

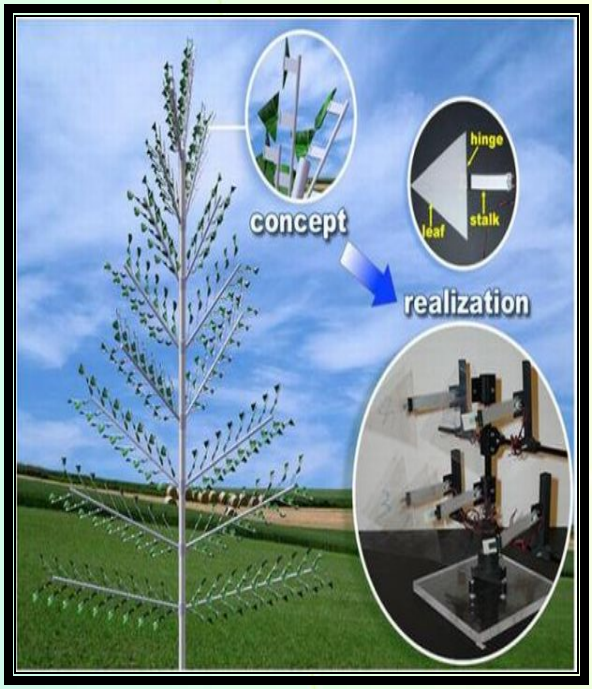
The nano leaves have been specially designed to imitate the Z-scheme of natural process of photosynthesis. The mechanism by which, typical plants absorb the light emitted by the sun and CO_2 in the atmosphere. The artificial trees do even copy the natural re-cycling process. It is very recent that nano leaves technology started to reap even more advanced levels. It can now harvest thermal energy as well. Moreover, the leaves fixed on artificial trees are also able to collect energy derived through movement of the wind, known as kinetic energy, which is as well converted into electrical energy

It is a developing science attempting to solve human difficulties by adapting to and implementing nature's systems into human technology. This job is accomplished by way of the use of nature's design with synthetic trees, shrubs, plants and flowers all developed with nano-leaves engineered photo-voltaic (PV) cells. This emerging yet brilliant method of energy creation is both clean and renewable with a broad range of applications.

In biomimicry concept, trees are fitted with nanoleaves. The nano-leaves have been specially designed to imitate the natural process of photosynthesis (an organic mechanism by which plants absorb the light emitted by the sun and CO_2 in the atmosphere, turning it into nutrients and oxygen). The artificial trees will even copy the natural recycling process of carbon-dioxide to oxygen conversion. It is only recently that nano-leaves technology started to progress to even more advanced levels; It can now harvest thermal energy in addition to solar.

The nano-leaves transform the whole solar spectrum of light; Converting detectable light, infrared and ultraviolet into electricity. This works in conjunction with the piezo-electric generators that convert

wind energy into electricity providing efficient, cost effective and attractive looking solutions, while providing the sustainable electric power (Fig. 7).



Source: http://heightech.blogspot.in/
Figure: 7 Energy Harvesting 'Piezo-tree' Concept

Solar energy + Wind + heat energy= electrical energy

For constructing the artificial tree the first step is to construct the nano leaves . It utilises three different energy generation technologies such as photovoltaic, thermoelectric and piezoelectric.

NANO LEAF

Solar Botanic's artificial leaf called the "Nano leaf". A very thin photovoltaic film on one side of Nano leaf converts the light from the sun into energy. On the other side of the Nano leaf thin thermo voltaic film converts the heat from the solar energy into electricity. Small amounts of piezoelectric power are generated by stalks connecting to a branch. Nano leaf is thin like a natural leaf and the wind outside forces pushes the Nano leaf back and forth, and in petiole, twig and branches mechanical stresses appears. When thousands of Nano leaves flap back and forth due to wind millions of Pico watts are generated. Stronger the wind and more energy is generated. A small part of the sunlight is reflected by Nano leaves that strikes them. Rest of the spectrum and the green light is efficiently converted into electricity. Nano leaves converts the visible light and invisible light, known as infrared light or radiation, which can feel only. In Nano leaves has unique combination of photovoltaic and thermo voltaic and converts thermal radiation into electricity.

In the years ahead we will witness a world where there will be scarcity for energy resources, but we are fortunate that we are provided with solar power which will last for millions of years. And recently with the emergence of nanotechnology, scientists are working on a new concept called **"nano-leaves"** that will help produce electricity through solar power; It's anticipated this novel technology will serve near-term and long-term energy requirements, in anticipation of upcoming expected energy demands (Fig. 8).

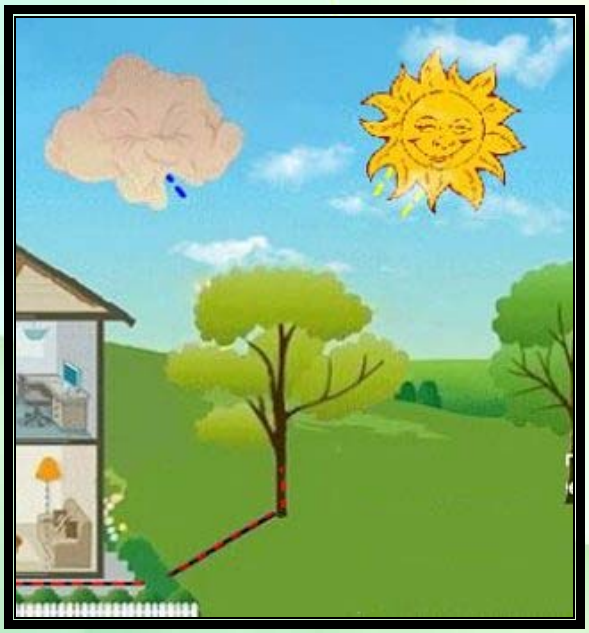
Source: http://www.ijater.com/
Figure: 8 Nano leaf

One of the emerging nanotechnologies related to renewable energy is nanoleaves and stems of artificially created trees or

plants. They are an emerging form of renewable energy through collecting energy from the sun and wind and converting it to electrical energy. The leaves are distributed throughout artificial trees and plants, and when operating at optimum efficiency can supply a whole household with electricity (Fig.9). By using this new technology, we can harvest the energy of the sun and wind by embodying substantiated science. Also existing source of renewable energy, solar panels, arabolic sun collectors, wind and tidal turbines are inefficient, expensive and environmentally insensitive.

SolarBotanic's Nanoleaves create electricity in three ways:

1. Nanophotovoltaic generators in the leaf directly convert solar energy to electricity.
2. Nanothermoelectric cells convert solar heat to electricity.
3. Nanopiezo generators can also convert wind energy in to electrical energy.



Source: http://www.ideaconnection.com/
Figure: 9 Artificial Trees Capture Both Sun and Wind Energy

COMPOSITION AND DESIGN OF NANO LEAVES

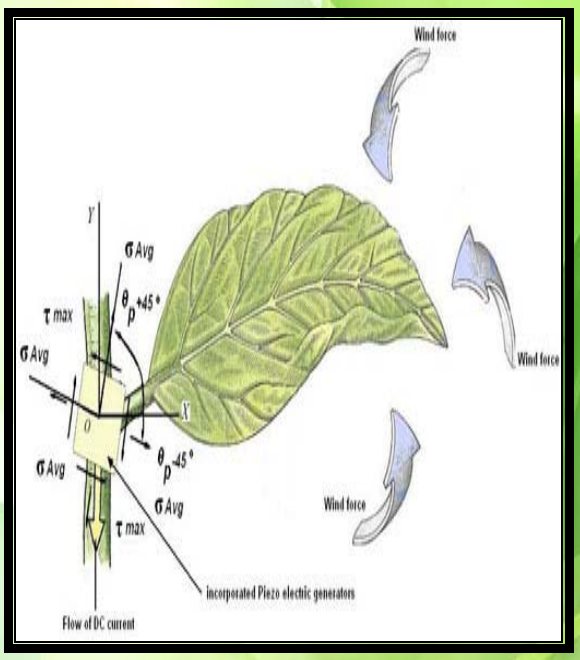
The nanotrees mimic the Z-scheme of natural photosynthesis by creating space for electrons to move between the catalysts in their nanotrees. The trunks carry out the hydrogen-generating portion of the reaction, while the branches carry out the oxygen-generating portion. This allows both reactions to take place simultaneously for maximum efficiency. Under simulated sunlight, they can convert 0.12 percent of the light into fuel, an efficiency comparable to that of natural photosynthesis.

Thermal Energy

This is captured through the use of thermo voltaic (TV) cells which convert thermal energy into electricity by using semi-conducting materials (a material which is between a metal and an insulator; its conductivity increasing with temperature rise (Fig. 10 &11).

Light Energy

There are also tiny photovoltaic cells (PV) incorporated in the nanoleaves. These small PV cells capture the light rays emitted by the sun. The light is then converted into electricity.



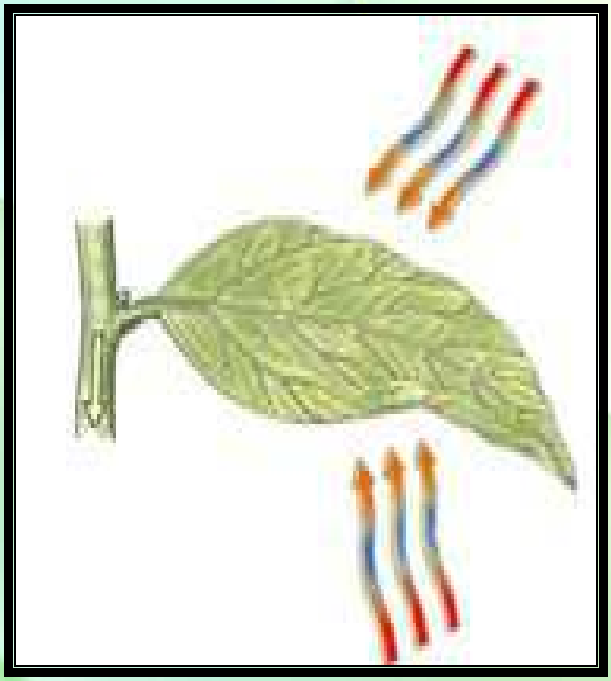
Source: http://heightech.blogspot.in/
Figure: 10 Solar Botanic technology is used to separate the carbon dioxide from other elements in the air

Kinetic energy

Kinetic energy is harnessed through movement. The wind produces motion in stems and branches. This motion is collected via piezovoltaic (PZ) cells. The PZ has semi-conducting devices incorporated into the artificial structure of trees and plants. The PZ and the semi-conducting devices convert typical wind energy (kinetic energy) into electricity.

Titanium Oxide (Tio_2)

The nano leaves are designed by using the TiO_2 nano par-ticles because its very effective power generating nano par-ticles and cost is very less. So in cosmetic and skin care products, titanium dioxide is used as a pigment, sun-screen and a thickener. Titanium dioxide is produced in varying particle sizes, oil and water dispersible, and with varying coatings for the cosmetic industry. This pigment is used ex-tensively in plastics and other applications for its UV resis-tant properties where it acts as a UV absorber, efficiently transforming destructive UV light energy into heat.



Source: http://heightech.blogspot.in/
Figure: 11 Nanoleaves convert the whole spectrum of light into electricity

TYPES OF NANO LEAFS

Broad Leaf trees

These trees can provide between 3500kWh and 7000kWh per year. They provide shade, cooling the
air, green ambiance and much more.

Evergreen trees

These trees can provide between 2500kWh and 7000kWh per year. They can beplaced as single trees or to fence garden properties.

Plants in Roof, Wall and Fencing

A wide range of shrubs for all electrical needs. Nano leaf roof Carpets can be installed in minutes on any roof design. Wall carpets are easy to apply as fencing (Fig. 12).

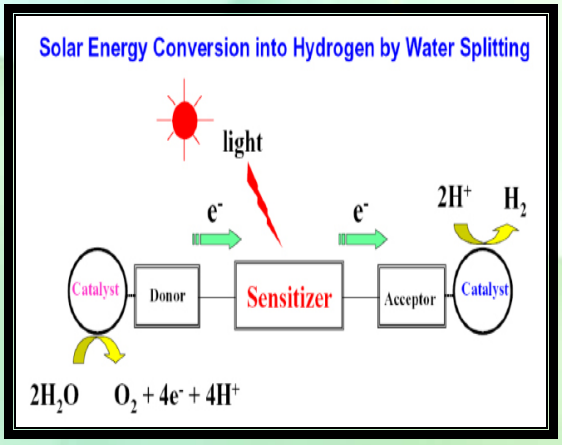
Source: https://www.internationalrivers.org
Figure: 12 Nano leaves create electricity

MECHANISM OF PRODUCTION OF ELECTRICITY

When Sun light falls on the nano-leaf, the photons are absorbed into the nano-leaf, their energy causes the electrons to become free. The electrons moves towards the bottom of the nano-leaf and exit through the connecting nano wires working as trunk. This flow of electrons is referred to as low electricity (Fig. 13).

Source:http://www.spgenergy.com
Figure: 13 Nano leaf at works

- ✓ In the same manner when the environment is hot, the **thermo voltaic layer** produces the electrical energy.
- ✓ If leaf is getting stress due to wind or rain, then **piezo electric layer** produces the electricity.
- ✓ If other type of light falls on the nano-leaf, then **photo voltaic** produces the electricity.
- ✓ The output of each layer is connected to the **single storing device** at the bottom of the tree.
- ✓ Thus in our nano-tree three effects are united and working at a time.



Schematic Digram of solar energy conversion

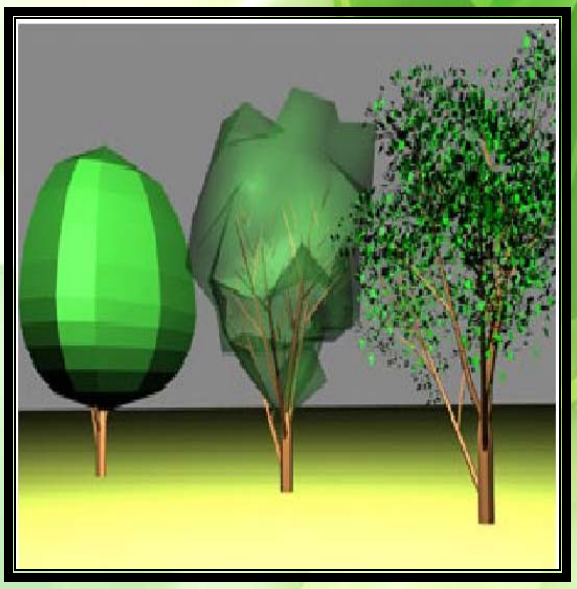
APPLICATIONS OF ELECTRICAL ENERGY FROM NANO LEAVES

The use of piezovoltaic, thermovoltaic and photovoltaic cells does effectively convert an amalgamation of energy sources into electricity. The photovoltaic, piezovoltaic and thermovoltaic energy harvesters are linked to individual junction boxes, from where they are amalgamated and fed collectively into an inverter. This converts the electricity from Direct current (DC) into Alternating Current (AC). The electrical power now being suitable for domestic or industrial use. Artificial energy trees can be used for both domestic or even industrial purposes. The manufacturers of the system estimate that a six meter area of nanoleaves canopy will generate enough electrical power to supply an average household. More, intricate is that, artificial trees can be constructed at various areas, like, deserts, parks, office, premises and industries etc.

- **Deserts**

The power supplied by these trees "planted" in the desert can be used to power desalination plants to produce fresh water from seawater and brackish water aquifers. This water can then be used for drinking and land irrigation, without any environmental damage to the fragile desert environment.

Trees can be planted alongside oases and over fresh water aquifers, with the electricity produced used to power down-hole pumps, enabling water to be piped to other locations.



source: http://www.energymatters.com.au/
Figure: 14 Botanic trees

When planted along the desert roadways, trees will supply shade as well as protection from the sun, wind, and sandstorms (Fig 14).

- **Parks, Recreation Grounds, and Golf Courses**

The electricity produced can be used to charge electrically powered ground maintenance vehicles such as grass cutters as well as electrically powered hand tools like grass trimmers and pruning shears. When planted on golf courses the power produced can be used to charge golf buggies as well as electrically powered ground maintenance vehicles.

- **Office Car Parks and Industrial Units**

Nano trees planted in these locations will not only supply electrical power for the office and industrial units, but add aesthetic qualities to an otherwise drab area, whilst providing shade from the wind and sun.

- **Charging Purposes**

Solar powered tree to charge mobile devices and it can also be used for charging laptops. Solar powered tree can be used during night time to lights up the street lights.

- **Electric vehicles**

The depletion of petrol and diesel resources results in emergence of electric vehicles. These solar and wind powered trees can provide plugins for electric vehicles and hybrids of the near and distant future.There are various other applications where we can utilise the electricity generated by Energy harvesting trees. This is a very novel method to generate electricity using renewable sources i.e. solar energy and wind energy (Fig. 15).

Source:http://greenplanetethics.com
Figure: 15 Energy from renewable sources.

ADVANTAGES

- Both the role of Paying homage to photosynthesis and the Photosynthesis tree are gracefully plays by Solar tree.
- A positive environmental impact opposes to a negative one..
- On street lighting in the area, Power outages have no impact .
- In all locations Solar street lights can be easily erected .
- No air pollution energy sources.
- In poor country people would access electricity
- People can save money
- Land requirement is very less

DISADVANTAGES

- Cost is high.
- It is dangerous to the birds and insects.
- It is dangerous to eyesight from solar reflectors.

FURTHER SCOPE

- To Use this electricity in driving the car.
- By Increasing the dimensions of leaves to increase the production of electricity.
- To use in the heavy transport systems
- To make efficient the nano-tree for Photosynthesis

CURRENT NEWS

Limitless power from Nano-forests

A team of electrical engineers based at the University of California in San Diego has created a nanowire tree which can generate hydrogen gas from water.

That is significant because hydrogen is seen as the ideal fuel of the future as it can be used to provide energy without releasing greenhouse gasses.

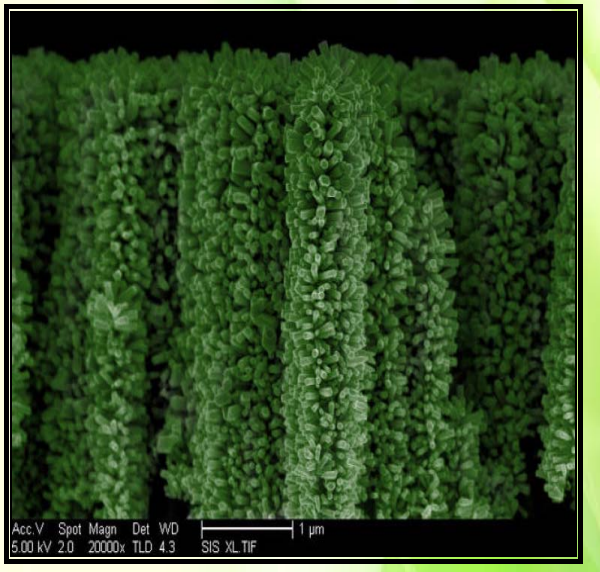
Nanotrees could, in theory, be used to create large quantities of hydrogen, and, therefore, energy – without producing these harmful greenhouse gas emissions.

A forest of nanotrees is then placed in another solution and exposed to sunlight. At this point, the silicon nanotrees' 'trunks' soak up the sunlight and transfer electrons through their zinc oxide branches into the surrounding water. That reaction creates hydrogen gas, which bubbles up through the water. Prof Wang and his team are trying to work out the most efficient way to collect that hydrogen. One possibility is that they'll construct a two-compartment cell, one side a cathode and the other an anode, which could be used to collect the hydrogen and ultimately use it to produce electricity.

Source:http://metro.co.uk

Nanotrees harvest the sun's energy to turn water into hydrogen fuel

Another research was also done in the same institute where, Researchers of University of California, are building a forest of tiny nanowire trees in order to cleanly capture solar energy without using fossil fuels and harvest it for hydrogen fuel generation. The team said nanowires, which are made from abundant natural materials like silicon and zinc oxide, also offer a cheap way to deliver hydrogen fuel on a mass scale (Fig. 16).



Source:http://www.sciencedaily.com/releases/2012/03/120307112312.htm

Figure: 16 Nanotrees Turn Sun and Water into Hydrogen Fuel

Nano-'Trees' Use Solar Energy to Split Water.

The researchers at Berkeley Lab have developed a new device is actually a combination of nanowires made of silicon and titanium oxide. These materials are both semiconductors that react with light, but different parts of the spectrum. Silicon operates in the visible and infrared ranges, while titanium oxide reacts to ultraviolet light. When exposed to sunlight, the two materials also do different things as the silicon adds electrons to protons to produce hydrogen, and the titanium oxide pulls the oxygen out of water molecules. To improve performance, the titanium oxide nanowires are arranged like a forest on the larger silicon nanowire. This configuration increases the surface area to interact with water and helps capture sunlight.

The device only achieves 0.12% solar-to-fuel conversion efficiency, which is not horrible, but does need to be increased for commercial use. Fortunately the researchers already know one way to optimize the system by matching the energy outputs of the silicon and titanium oxide.

Source:http://www.overclockersclub.com/

Solar power from energy-harvesting trees

Scientists at VTT Technical Research Centre of Finland have developed a prototype of a tree that harvests solar energy from its surroundings - whether indoors or outdoors - stores it and turns it into electricity to power small devices such as mobile phones, humidifiers, thermometers and LED light bulbs. The technology can also be used to harvest kinetic energy from the environment such as wind, sunshine, vibrations and fluctuations in temperature (Fig. 17).

Fig: 17 Energy harvesting tree

The "leaves" of the tree are flexible, patterned solar panels made using a technique developed by VTT on a printing process. The leaves form an electronic system complete with wiring that conduct energy into a converter that feeds electricity to devices such as mobile phones or sensors analysing the environment. The tree trunk is made with 3D technology by exploiting wood-based biomaterials. VTT's technologies create endless opportunities for applications involving different kinds of electronics regarding lighting and energy harvesting. The more solar panels there are in a tree, the more energy it can harvest.

Source:http://www.energyharvestingjournal.com/

A tree may have the answers to renewable energy

Xudong Wang, an assistant professor of materials science and engineering at UW-Madison, recently collaborated with researcher, Dr. Zhiyong Cai, in the U.S. Forest Products Laboratory in Madison on research to use cellulose nanofibers (CNFs) for water splitting, a process that converts solar energy to hydrogen fuel.

Wang's vision is to use cellulose like a sponge "tree" that soaks up water from a lake or ocean. At the top would be a photocatalyst that splits the water into hydrogen and oxygen.

Wang and his collaborators are soaking water up out of the body of water and splitting it in the air. At the top of their "tree" is a mesoporous titanium dioxide photocatalyst created on a cellulose template, which offers a huge surface area. Placed in a body of water, the tree's cellulose "roots" draw water up to the photocatalyst "leaves", where it reacts and splits into hydrogen and oxygen.

Source: http://phys.org/news

Mimicking photosynthesis with man-made leaves

Osamu Ishitani at the Tokyo Institute of Technology, along with researchers from Toyota Central R&D Labs, Inc., has created an efficient, artificial light-harvesting system based on the natural two-step process of photosynthesis. The new system uses man-made 'leaves' as light absorbers, which relay energy through a metal complex to feed a final energy acceptor.

"It is difficult to make an efficient solar-energy converter using molecular devices such as so-called photocatalysts because the molecules are so small and solar light is so dilute," explains Ishitani. "Such systems would require huge numbers of molecular devices, which are expensive and time-consuming to make. Introducing devices with the ability to harvest light

into solar-energy conversion would be one possible solution."

The researchers created a device with 440 'leaves' using tubes made from so-called periodic mesoporous organosilica (PMO) and light-absorbing biphenyl (Bp). The PMO-Bp complexes were linked to five connected rhenium metal sticks, which transferred the light energy harvested by PMO-Bp directly to a central ruthenium sphere. In this way, the photons from the light source were concentrated very efficiently, first through the rhenium sticks and then into the ruthenium reaction center, with little loss of energy en-route.

Source: http://phys.org/news

Cheaper LED with 25 times more power developed

WASHINGTON: Scientists have developed a new type of light-emitting diode (LED) using an organic-inorganic hybrid that could lead to cheaper and brighter lights and displays in the future.

The researchers used a class of materials called organometal halide perovskites to build a highly functioning LED. Perovskites are any materials with the same type of crystal structure as calcium titanium oxide. "The material glowed at about 10,000 candelas per square metre at a driving voltage of 12V. "Such brightness is due to the inherent high luminescent efficiency of this surface-treated, highly crystalline nanomaterial," said Hanwei Gao, assistant professor of physics. Present LEDs glow at about 400 candelas per square meter.

Source: http://timesofindia.indiatimes.com

FUTURE USE OF NANO ENERGY TECHNOLOGY

- ✓ Novel lighting materials (OLED: organic light-emitting diodes) with nanoscale layers of plastic and organic pigments are being developed; their conversion rate from energy to light can apparently reach 50 % (compared with traditional light bulbs = 5%).
- ✓ Nanoporous insulating materials in the construction business can help reduce the energy needed to heat and cool buildings. Nanomaterials could improve energy generation and energy efficiencies.
- ✓ The electrical energy produced by these nano trees can be used to:
  - ➢ Drive the cars.
  - ➢ To enlighten the home
  - ➢ For business purpose
- ✓ It can be used as the balancing factor between power prediction and environment
- ✓ The main advantage is that it is used in efficient and green energy production which can restrict global warming

CONCLUSION

Nano tree was developed the first multifunctional renewable energy systems that actively converts light, heat and wind into useable electricity, day and night, and we are continuously looking for ways to make them as efficient as possible. It convert the visible light into electricity". These super eco friendly synthetic trees will make use of renewable energy from the sun along with wind power, which are an effective clean and environmentally sound medium of gathering solar radiation and wind energy. Solar nanotechnology has wide-ranging potential. Using such technology, power producing solar products could be applied to just about any surface downtown or anywhere. These artificial trees not only will make the world stable in the field of energy but also will reduce the use of fossil fuel which is the main cause for the world's largest problem global warming'.More research will need to bring the technology from laboratory to home for common use.

FORTHCOMING EVENTS		
Events	**Date**	**Place & Correspondence**
The Fundamental Science of Nanotechnology	11 January – 20 March 2016	Oxford, United Kingdom https://www.conted.ox.ac.uk
International Conference on Nanoscience and Nanotechnology (ICONN)	7–11 February 2016	Canberra, Australia http://www.ausnano.net
Kuwait International Nanotechnology Conference & Expo	9–11 February 2016	Kuwait City, Kuwait http://www.nanotechkw.com/
International Conference on Nanobiotechnology (ICNB'16)	1-2nd April, 2016	Prague, Czech Republic http://nbconference.com
Global Nanotechnology Congress and Expo	21-23rd April, 2016	Dubai , United Arab Emirates http://www.scientificfederation.com

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