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PHOTOVOLTAIC GLAZING USING LUMINESCENT SOLAR CONCENTRATOR

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Abstract
One presents in this paper an idea to use switchable technologies such as photovoltaic glazing into buildings installed in a variety of applications such as windows, skylights, roofing walls etc. This technology will control the solar heat flow and the visible light transmission through windows and potentially collect infrared radiant power on a photovoltaic cells. When sunlight shines on the photovoltaic cell the photons bombard and carry their energy down through the cell and electron use this energy to jump and flow around the circuit and produce electricity. The conversion of solar panels into thin transparent glass is possible due to quantum dots based luminescent solar concentrators. LSC is a light management device which can serve large area as a sunlight collector. LSC use quantum dots as they poses widely tunable re-absorption and emission property. The LSM seems a promising technology with the large diffusion potentialities in architecture, thanks to the transparency combined with energy production. This research is carried out by LOS Alamos National Laboratory research team which took an important step towards demonstration in quantum dot, solar powered windows from the laboratory to the construction site. The researchers has expanded the way of producing energy with minimizing the impact on the environment surrounding which is the motive of laboratory mission. Herein we have described factors affecting the production of electrical energy in photovoltaic glasses using luminescent solar concentrators and what photovoltaic glazing system includes. By implementing this technology the generation of electrical energy cost can be reduced up to 90% lower than other electrical energy generating systems.

Keywords: *Photovoltaic Glazing, Luminescent Solar Concentrators, Quantum dots, Solar Energy.*

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1. INTRODUCTION

According to researches, the global demand for electricity continues to rise at high rate. This incremental demand is supplied by fossil fuels by 70%, while the remaining 24% is supplied by nuclear energy and hydropower and only 6% is supplied by renewable energy which is most abundant in nature. Renewable energy have the characteristics of generating clean energy available in nature, which can replace exhaustion of fossil fuels and can reduce emission of greenhouse gases. The objective of this paper is how to use renewable energy by harnessing the solar energy of sun by photovoltaic glazing by using LSC.

Photovoltaic system is a direct conversion of light into electricity at the atomic level. When photons from sun pass through silicon wafers, the electrons are loosed, this produces current that flow from panels into batteries or the grid. Photovoltaic glazing converts light energy into electrical energy. This glazing incorporates transparent semiconductor (quantum dots) –based photovoltaic cells. The cells are sandwiched between two sheets of glass. This technology is proved to be scaled up by palm sized area to large area to put enough power in buildings. These glasses can be used in integration of buildings.

Fig.1. Building Integrated With Photovoltaic Glasses

2. LUMINESCENT SOLAR CONCENTRATORS

Luminescent solar concentrators is one of the recent technology which helps to develop photovoltaic glasses. Luminescent solar concentrators are constituted by sheet of transparent plastic or glass materials doped with Quantum dots(a quantum dot is a semiconductor nano-crystal with unique properties distinct from bulk semiconductors whose typical life span is 25-30 years). The quantum dots absorb part of sunlight and concentrate at the edge of the sheet where small photovoltaic cell convert it to a electrical energy the device exploits the wave guide effect of the sheet that acts like an optical fibre. The luminescent concentrators of this type can be used to build transparent

photovoltaic panels which yield lower than normal silicon photovoltaic cells but with peculiar characteristics of transparency which is very useful in many applications in the field of building integrated photovoltaic (such as in windows, in greenhouses, to make noise barriers etc.) where transparency is the essential feature. Quantum dots are one of the essential part of luminescent solar concentrator technology to increase the efficiency of photovoltaic glasses.

2.1. Why Quantum Dots?

1. Quantum dot is third generation of photovoltaic cell which cost less than comparative to other photovoltaic cell.
2. Quantum dot converts short wavelength of light into long wavelength of light which provides high efficiency.
3. Quantumdot helps to make nearly transparent glasses.
4. Quantum dots are light weight and versatile in nature.
5. Quantum dot is a complex composition of copper, indium, sulphur, selenium.

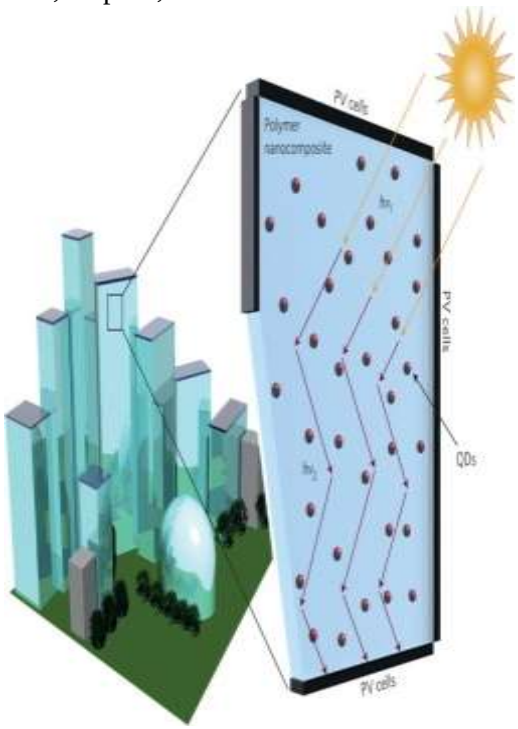

Fig.2.1 Working Of Quantum Dots In PV Glass

2.2 Why To Use Photovoltaic Glazing Over regular PhotovoltaicPanels ?

Solar panels usually comes in a one color. Dark!That is because they use a dark sheet of silicon crystal to absorb the sun rays that turned them into electrical energy. Solar panels are used at roofs but almost all the sun catching areas are in side of building which are usually design to let light in. We cannot use whole area of roof for solar panels but if we can integrate solar panel at side and facades of the building, we can use much more area which will give us more space for trapping solar energy. We can plaster the regular silicon based solar panel at side of building but it will not even let a little sunlight to enter in and which is difficult to integrate in buildings. Scientist recently invented solar panels that look like a window which are known as photovoltaic glasses.

2.3 Working Of Photovoltaic Glass Using LSC

This photovoltaic glass is embedded with thin layer of tiny silicon particles called as quantum dots that absorbs the some part of light and letting the rest pass through quantum dots ,then quantum dots re-emit the energy in longer wavelength which reflects on window panels rather than escaping because of physics thing called total internal reflection and because quantum dots only absorb short wavelength, those re-emitted waves travel through the plate and will be absorbed by another dots and when they reach the edge they hit tiny solar cell that covert them into electricity because this solar windows capture some sunlight ,they are not 100% transparent. These glasses are coated with LSC to keep maximum amount of energy out and a tiny amount in.

3.INTEGRATION OF PHOTOVOLTAIC GLAZING SYSTEM IN BUILDING.

The photovoltaic glazing can be efficiently integrated in places such as shading devices, windows, fanlight, arcades, agricultural green houses, glazed courtyards etc. The photovoltaic glasses can be successfully integrated into building fabric with good design with good energy concept. This system should be integrated where energy conscious design techniques have been employed, system have been carefully selected and specified. We should not consider its initial cost but also its overall cost because it reduces building material and labor cost.

3.1 Measures To Be Taken While Designing In Building

1. One should consider local climate and environment .
2. One should consider site planning and orientation issue.
3. One should consider orientation of array.
4. One should provide appropriate ventilation.
5. One should consider the requirement between utility interactive PV system and stand-alone PV system.
6. One should consult professionals before designing.

3.2 A Complete Photovoltaic Glazing Includes:-

1. The PV glass (might be thin film of crystalline, transparent, semi-transparent or opaque).
2. a charge controller to regulate the power in and out of the battery storage bank.
3. Storage can be comprised of utility grid interactive system or a number of batteries in stand-alone system.
4. Power conversion equipment includes an inverter to convert the power generated DC to AC.
5. Backup power supplies such as diesel generators.

6. Appropriate support and mounting hardware, wiring, and safety disconnects.

4.FACTORS AFFECTING PRODUCTION OF ELECTRICAL ENERGY

1] The local weather of the site. The much hot region more will be the efficiency as its production is directly proportional to amount of sunlight it gets. It is also dependent on other factors such as latitude and longitude.

2] It depends on efficiency of panels. The efficiency of photovoltaic glass is approximately 25-30%.

3] The area which is available for integration of panels.

4] The electronic system use for power conversion.

5. ADVANTAGES OF PHOTOVOLTAIC GLAZING.

1. Energy produced from these glasses is clean energy. It does not causes any harm to environment natural resources or endanger animal or human health.
2. This technology uses a locally available renewable resource. It does not need to be imported from other regions of the country or across the world. This reduces the impact associated with transportation.
3. Unlike fuels that are mined and harvested before using when we use solar energy to produce electricity we do not deplete or alter the resource.
4. It is aesthetically pleasing.
5. It can be vertically integrated in buildings which is convenient for space limited areas such as big cities.
6. It can be retrofit.
7. This technology contributes to control the temperature inside the building allowing great saving on air conditioning system which is possible due to filtering effect of LSC .
8. It improves both thermal and acoustic insulation and filter ultraviolet and infrared radiation.
9. In PV glasses we don't need to provide any weather tight barrier

6. DISADVANTAGES OF PHOTOVOLTAIC GLAZING

1. Its efficiency is dependent on source of sunlight, as sunlight varies in different season its efficiency will also varies in different season.
2. It has high cost than normal windows.
3. Technologies currently available on market are not fully transparent
4. Has much lower conversion efficiency than PV module.

7. FUTURE SCOPES

In future, the other options are on the way where photovoltaic glass can be applied such as mobile phones .with photovoltaic screen, in car's windows where we can consume little amount of energy for air conditioning, charging etc. Scientist are working on how to reduce its cost and increase its efficiency, thus we are expecting this technology to be more economical in future and lead to concept of 'zero energy' building.

8. CONCLUSION

Advancement in photovoltaic glazing of course has very wide range of applications. The latest technology LSC based on quantum dots is one of the evolution in photovoltaics that can to be game changing method in consumption of electrical energy. With some further developments, the product might improve its efficiencyand may come in wide varieties of design and may become more economical.

Hence, we can say Solar Glass, a Window to the Future of Energy.

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