Physical Electronics

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Project 2

Due Date: October 28, 2013

**Emerging Trends in Solar Cell Technology:**

**Efficient and low cost Design Principles and Alternative Solutions**

A photovoltaic (PV) cell, also known as “solar cell,” is a semiconductor device that generates electricity upon interaction with light. Photons with less energy than the band gap failed to be absorbed, while photons with energy higher than the band gap are being absorbed, however, excess of energy is excess energy is dissipated as heat. The maximum efficiency that a solar cell made from a single material can theoretically achieve is about 25-30 percent.

**Amorphous silicon** is an entirely non-crystalline form of silicon that can be thought of as grains the size of the individual atoms.

On the other hand, standard **poly-crystalline silicon**, also called poly-silicon, consists of 0.5 to 1 micrometer discrete grains, or crystals, of mono-crystalline silicon that generate regions of highly uniform crystal structures, therefore, of different refractive indices, separated by grain boundaries.

**Thin films (PV) cells** are being deposited on glass, metal or plastic foils.

**CdTe semiconductor** PV is very promising solar cells semiconductors.

**Quantum dots** tend to improve efficiency of solar cells by extending the band gap of solar cells for harvesting more of the light in the solar spectrum, as well as by generating more charges from a single photon, leading to increased quantum efficiency.

To enhance the energy conversion efficiency of thin-film silicon solar cells, light trapping is commonly used. Light trapping can be achieved by means of textured transparent conducting oxide (TCO) films, quantum dots, graded-index materials or other efficient techniques. As result, enhanced light absorption is obtained through different key-mechanisms, such as scattering at rough interfaces that enhances the quantum efficiency, total internal reflection between the back and front contacts confining the light inside the absorber layer, quantum dots (please, see above), and other.

1. Introduce carefully the principles of solar cells (short description). You may address any inorganic or organic (polymer) solar material.
2. Present carefully NEW technologies aimed to increased absorption efficiency, quantum efficiency, or light trapping efficiency (new materials, new thin films, new trapping techniques). Limit your study to the latest technologies of the last three years.
3. Relate optical to electrical conversion process, carefully using theoretical formalism.
4. Analyze their engineering principles/fabrication techniques
5. Characterize these materials in terms of electrical/optical parameters (some numerical examples, calculations) will be extremely helpful. Identify potential figure of merits (FOM)’s, such as responsivity, sensitivity, polarization, efficiencies, optical-to-electrical conversion, and so on.
6. Discuss the advantages and disadvantages with respect to its peers in terms of cost/benefit/engineering value.
7. Summarize carefully your conclusions. Please, present detailed reference list.

Helpful Information

<http://newenergyandfuel.com/http:/newenergyandfuel/com/2010/05/05/building-a-much-lower-cost-solar-cell/>

<http://www.pddnet.com/news-university-of-souther-california-a-new-breed-for-solar-cells-072310/>

<http://www.thaindian.com/newsportal/health/new-flexible-and-lightweight-solar-cell-developed-by-scientists_100321038.html>

<http://www.technologyreview.com/computing/22958/?a=f>

Please e-mail your contribution at: [giakos@msn.com](mailto:giakos@msn.com), as well as provide a hard copy!

Several teams should be involved during this study. Each team should consist of 2-3 members. Each member should add each own contribution on the study. This should be identified clearly on the submitted manuscript.

Please go to the next page→

Report Guidelines: IEEE Format

Abstract: 50-100 Words *(in italic)*

1. Introduction

Introduction of the Quantum Dots

Literature Search (main body of references)

1. Problem Definition

Definition of an Area of Interest/Address Problems/needs/demand

1. Applied Methodology

Present Design Principles

Material Characterization

Systems Analysis/Procedures/Techniques

1. Discussion

Advantages Disadvantages

Comparison with peers

Applications/Potential

1. Conclusion
2. Acknowledgement
3. Reference List (IEEE Format)

Examples

[1] Richard G. Priest and Steven R. Meier, “Polarimetric microfacet scattering theory with applications to absorptive and reflective surfaces” Optical Engineering, vol. 41, pp. 988– 993, May 2002.

[2] G. C. Giakos, “Multifusion Multispectral Lightwave Polarimetric Detection Principles and Systems”, IEEE Transactions on Instrumentation and Measurement, vol. 55, no. 6, pp. 1904-1912, 2006.

Please, use figures and diagrams widely. Please, quote reporting information (reference) next to each figure.