New Production Methods of Nanocrystal Solar Cells

Prajakta Pritam Desai1,Prachi Prakash Shinde[2] and Harshwardhan Chandrakant Pandit[3]

[1]Sanjay Ghodawat Institutes, Atigre, Affiliated to Shivaji University,patil.pr@sginstitute.in
[2]Sanjay Ghodawat Institutes, Atigre, Affiliated to Shivaji University,shinde.pp@sginstitute.in
[3]Department of Technology, Affiliated to Shivaji University,mahapandit123@gmail.com

ABSTRACT:

The use and production of efficient solar cells is an important aspect in today's generation. The various methods are available to produce solar cells. The scalable technology at room temperature for the fabrication of ultrathin films based on surfactant-free surface-engineered silicon nanocrystals (SiNCs). Environmentally friendly pulsed fsec laser induced surface engineering of SiNCs and vacuum low-angle spray deposition is used to produce ultrathin films. This gives high efficiency of solar cell. Another method is silicon photovoltaic cell in which the silicon, molybdenum and aluminum materials are used.

Key Words: Nanocrystal, Silcon, solar energy

1.INTRODUCTION:

Now days, as population is increasing, demand of the energy also increases. The conventional energy sources are insufficient to fulfill the human needs up to the end. Renewable energy sources are best alternative for this which cannot vanish. Among the renewable sources, solar energy is best source of energy which can directly converted into electric energy. Nanocrystal solar cells are the types of solar cell with nano material coating over the surface of cell. The nanocrystal materials used are silicon, CdTe/CIGS and substrates are silicon or various organic material. The commonly used approaches in solar cell are quantum dot solar cells and Dye –sensitized solar cells. In this paper we will look for basic production methods and their results of nanocrystal solar cells.

2.PRODUCTION METHOD :

2.1Manufacturing process of silicon photovoltaic cell:

Generally silicon is taken from the silicon industry and then by using silicon dioxide, the impurities in silicon are removed. The quality of silicon substance get enhanced. Then the substances are heated upto its melting point then the seed crystal is deeped in the liquid silicon solution. Then move the seed crystal in upward direction, it looks like rod. Cut the solution as per requirement. Then the slicing wafers are formed as shown in fig1.

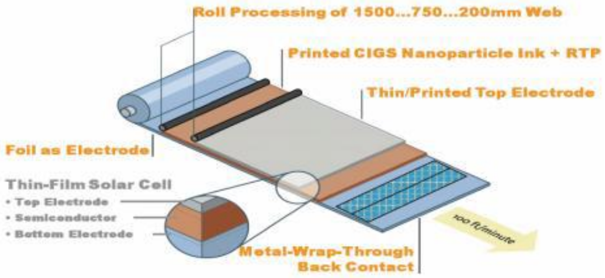

Fig.No.1.**Slicing wafers of silicon**

In the procedure, first the aluminum foil is pressed at the bottom layer which works as electrode. The thin layer of molybdenum is printed on this Aluminum layer. By using semiconducting ink, P/N junction layer, and a zinc oxide electrode conducting layer, another three layers are presses over this. After this the module encapsulation process is made. In this process, at the bottom we can place aluminum or glass. Over it place an EVA and then kept solar cells. Finally place aluminum pate over solar cell. Place this photovoltaic system on the roof of house as shown in fig. No.1. Working of nano solar cells: 1. Light passes to the middle semiconducting ink layer, which breaks up the electrons. 2. The molybdenum on the fourth layer acts as an electrode, and as the end of the circuit. 3. The second layer is a P/N junction, which conducts the electrons through to the top layer. 4. The top layer conducts the electrons and work as the beginning of the circuit.

 DOI : 10.18231/2454-9150.2018.0214

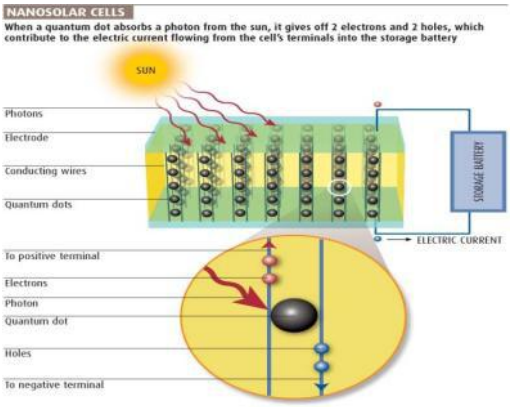

Fig No. 2. **Working of photovoltaic system**

2.2 Manufacturing of fabrication of ultrathin films based on surfactant free surface- engineered silicon nanocrystals(SiNCs):

SiNCs were produced by electrochemical etching of p-type Si wafers for 1 h, which yields SiNC agglomerates. The fsec laser treatment is used for both SiNC deagglomeration and simultaneous surface passivation. In particular, 5 mg of SiNC powder (i.e., SiNC agglomerates) from the electrochemical etching process is transferred into 5 mL ethanol. The fsec laser irradiation is used a wavelength of 400 nm and a pulse width 100 fsec. A barium borate (BBO) crystal is used to select 400 nm. During the irradiation, the glass container is rotated. The process is conducted at room temperature and for 30 min. The laser beam are shaped and focused onto a spot (2 mm in diameter) on the liquid surface by an optical lens with a focal length of 250 mm. The average laser power is set to be approximately 30 mW while using the repetition rate of 1 kHz.

2.2.1 Low-angle spray deposition method:

The colloids of SiNCs treated by the laser process are then deposited using the deposition system depicted in the schematic diagram of Figure 3 without any further step or filtration. This apparatus consists of a colloidal solution tank, stopper valve placed after the tank, and a spray nozzle. The IOTA ONE (Parker Hannifin Corporation, East Pine Brook, NJ, USA) valve driver for high-speed solenoid valves was used to control automatically the valve. The valve was used to perform pulsed deposition by stop/start action and by controlling the time interval. The pulse duration for the valve was set at 0.5 sec open and 1 sec closed, and repeated 30 times until the 5 mL colloidal SiNCs/ethanol dispersion was fully consumed. During deposition,the pressure in the chamber increased from 2×10^{-5} Torr to10^{-2} Torr. The actual sample preparation was done at room temperature on quartz or glass/indium-doped tin oxide (ITO)/compact-TiO 2/mesoporous-TiO 2 substrates resulting in a thickness of about 30 nm.[1]

2.2.2Fabrication of solar cell devices:

Glass substrates with patterned indium-tin- oxide (ITO) are cleaned by O_2 plasma. The TiO_2 compact blocking layer was formed by dissolving titanium (IV) isopropoxide and triethanolamine in ethanol, stirred for 2 h at 40°C, and then left for 24 h. The solution was spin coated at 5000 revolution per minute (rpm) for 30 sec and then annealed at 400°C in a furnace for 2 h. The mesoporous TiO_2 layers were deposited by spin coating (2000 rpm for 60 sec) a solution of commercial dyesol 18-NRT titania nanoparticle paste dissolved in ethanol in a 1:2 ratio of paste to ethanol. The films were then annealed again in a furnace at 400°C for 2 hour. Then by low-spray angle deposition at room temperature, 30-nm thick film of fsec laser surface-engineered SiNCs is deposited.The hole transport layer is prepared by dissolving 0.207 g of 2,2',7,7'-Tetrakis[N,N-di(4 methoxyphenyl)amino]-9,9'-spirobifluorene (Spiro-MeOTAD,Sigma-

Aldrich, St. Louis, MO, USA) in 1 mL chlorobenzene and deposited by spin coating at 3000 rpm for 30 sec. Silver metal contacts were deposited by thermal evaporation using a shadow mask. The resulting device active area is 0.04 cm^2 as shown in fig.No.3

 DOI : 10.18231/2454-9150.2018.0214

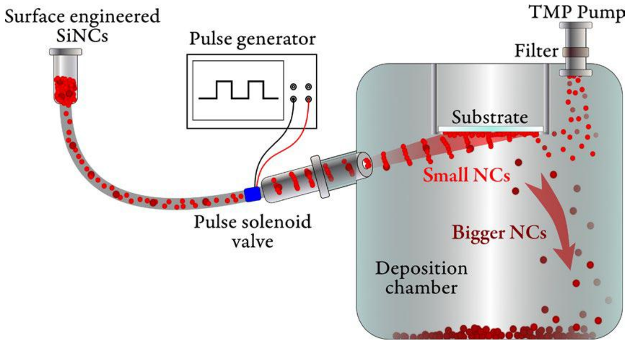

Fig.No.3: **Deposition system used to produce ultrathin surface engineered silicon nanocrystal films.**

3.ADVANTAGES OF NANO CRYSTAL SOLAR CELL

The nano crystal solar cells has less cost than conventional solar panels. This is more durable and versatile. Easily located and installed. As compared to electric power generation, solar cells are having 70% more efficient.[2]

4. DISADVANTAGES

The silver metal is used for interconnecting the panels. The silver metal has low resistance and having high cost which increases the cost of nanocrystal solar cell.

5. APPLICATION OF NANO CRYSTAL SOLAR CELL

These cells are best useful as ocean navigation aid. It is used in telecommunication. Due to the compact size and shape, this can be placed anywhere like cars, laptops, cellophanes, rooftops etc.[3]

6. CONCLUSION:

The energy demand increases day by day. Also sue to the excessive use of petrochemicals and other fuels, the global heat increases. To overcome such problems renewable solar energy source is best alternative. We have found many ways to product solar panels. The dye-sensitized nano crystalline electrochemical photovoltaic system has become a standard device for the conversion of solar energy into electricity these photovoltaic solar cells are cheap, compact and efficient. Another ultrathin surface engineered silicon nanocrystal films gives more efficiency and compact facility. The most beneficial advantage of nanocrystal solar cell is easy storage and handling. Still there is various scope to modify the production method of solar cell such as by using laser technology, by using new substitute interconnecting material over silver, the efficiency, rate of production can be increases. Further scope of solar energy sectors is in optimization and integration of operations of devises, tools and sensors in modern industrial society.

7. REFERENCES:

1] Vladimir Švrcˇek, Calum McDonald, Mickael Lozac'h, Takeshi Tayagaki,Tomoyuki Koganezawa, Tetsuhiko Miyadera, Davide Mariotti & Koji Matsubara," Stable ultrathin surfactant-free surface-engineered silicon nanocrystal solar cells deposited at room temperature",Energy science and engineering.

2] Michael Gratzel,"Nanocrystalline solar cells",Renewable Energy,Volume 5, Issues 1–4, August 1994, Pages 118-133

3] Shaik Ameer, Kosuri Venkateswara Rao,Shashi Shekhar Chaubey, Setty Abhinav," Nano Solar Cells: Adantages and Applications", International Journal of Electrical Electronics & Computer Science Engineering Volume 1, Issue 5 (October 2014), ISSN : 2348 2273

 DOI : 10.18231/2454-9150.2018.0214