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Review: 'Nano-composites and their Application in Photovoltaics'

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Abstract: *Current solar power technology has little chance to compete with fossil fuels or large electric grids. Today's solar cells are simply not efficient enough and are currently too expensive for large-scale electricity generation. However, potential advances in nanotechnology may open the door to the production of cheaper and slightly more efficient solar cells. Specifically, the topics that will be discussed in this review article include nano structured inorganic materials for photovoltaic applications. Solar cells require having a large specific surface area so that sufficient dye molecules and quantum dots can be adsorbed onto the inorganic materials. These absorbed materials act as antennae for optical absorption. The most outstanding advantage of nanostructures is their ability to create architectures with significantly larger internal surface area in view of their nano-scaled size. This feature of nanostructures enables them to be suitable for use in devices such as dye-sensitized solar cells, lithium ion batteries, super capacitors, and hydrogen storage systems. This review summarizes some of the important aspects and latest developments regarding applications of nano structured materials for energy conversion and storage.*

Keywords: *Conversion efficiency, Dye sensitized solar cells, Optoelectronic devices, III-V Dopes ferrites.*

I. Introduction

The discovery of quantum mechanics was of fundamental importance for understanding of semiconductors. Based on the advances in quantum theory in the early 20th century, a successful theory to explain semiconductor behavior was formulated by Kronig and Penny. However, a solid theoretical understanding of semiconductors was in place by the 1940s. Both germanium and silicon had been produced with increasing purity throughout the 1940s. The properties of silicon make it a much more attractive choice for solid state devices. While germanium is expensive and rare but silicon is the second most abundant element. Silicon has a higher breakdown field and a greater power handling ability; its semiconductor band gap energy is 1.1 eV at 300 K which is substantially higher than germanium's band gap energy of 0.7 eV. So silicon devices are able to operate over a greater range of temperatures without intrinsic conductivity interfering with performance. Early in 1948 Shockley developed a detailed formulation of the theory of p–n junctions that concluded with the conception of the junction transistor. This involved a thin n-doped base layer sandwiched between p-doped emitter and collector layers and vice versa. This p–n–p and n–p–n structures are the simplest form of the bipolar transistor, a technology which remains important in analogue and high-speed digital integrated circuits today. For some years the highest performance devices were manufactured using the so-called "mesa" process where the emitter and diffused base were raised above the collector using selective etching of the silicon. This processing technique was combined with some exciting thoughts at the end of the 1950s and led to the application of transistor devices and other components. In 1960 the first metal oxide semiconductor field effect transistor, MOSFET was demonstrated.

Like this silicon played very important role in designing electronic devices in the field of electronics. But In some crucial applications such as optoelectronics and very high speed electronics, silicon cannot perform but a wide range of compound semiconductors are better equipped to perform because silicon's band gap is indirect (an electron-hole recombination across the band gap must be accompanied by an interaction with a phonon in the lattice) which severely limits the potential efficiency of light emission from the material. More emphasis is being given to research based on materials other than silicon [1].Many of the important compound semiconductors, such as the alloys of III-V group semi conductors exhibit direct band gaps (binary BN, GaN, GaP, GaAs alloys, ternary AlGaAs, InGaN, AlGaN, alloys). These materials can efficiently emit brilliant light in light emitting diodes and laser diodes. Furthermore, in these alloy systems, where the band gap can be adjusted by changing the composition, there is a means of selecting the energy released when an electron and hole recombine across the gap and therefore controlling the wavelength of the photons emitted.

II. Role of Nano Technology in the Field of Solar Cells

Recent advances in energy storage may be attributed to energy applications of nanotechnology in which storage, conversion, manufacturing improvements by reducing materials and process rates, energy saving and enhanced renewable energy sources can be related. Energy conversion and storage involve physical interaction and/or chemical reaction at the surface or interface, so the specific surface area, surface energy, and surface chemistry play a very important role. The smaller dimensions of nano materials may also offer more favorable mass, heat, and charge transfer, as well as accommodate dimensional changes associated with some chemical reactions and phase transitions. For example, large specific surface area offers more sites for charge recombination in photovoltaics (2,3). And these materials are advantageous in offering huge surface to volume ratios, favorable transport properties, altered physical properties, confinement effects resulting from the nanoscale dimensions and have been extensively studied for energy-related applications such as solar cells, catalysts, thermoelectrics, lithium ion batteries, super capacitors, and hydrogen storage systems[4].

Shruti Sharma et. al. [5] in an interesting review provided several details about the development of the device solar cell. The development is basically hindered by the cost and efficiency. Inorder to choose the right solar cell for a specific geographic location required to understand fundamental mechanisms and functions of several solar technologies that are widely studied and reviewed a progressive development in the solar cell research from one generation to other, and discussed about their future trends and aspects. This article also tries to emphasize the various practices and methods to promote the benefits of solar energy.Thus most promising application of nanotechnology is solar cells. The basic design principle for solar cells is to increase the optical absorption of the active layer and/or reduce the electron loss during transport. The solar cells have layers of several different semiconducting materials stacked together to absorb light at different energies. Quantum dots are a promising type of nanostructure that may potentially lead to solar cells with internal conversion efficiencies over 100% owing to the multiple exciton effect. Nanostructures can be employed to improve the performance of solar cells by (1) bringing about new mechanisms, such as the multiple exciton generation effect in quantum dots, (2) providing large surface area, like the nano crystalline films used for dye sensitized solar cells, (3) generating unique optical effects to either reduce the light loss or enhance the optical absorption, based on the methods of antireflection, surface plasmon resonance, or light scattering.

III. History of Solar Cells

A solar cell (also called photovoltaic cell) is a solid state electrical device that converts the energy ofsunlight directly into electricity by the photovoltaic effect. Assemblies of cells are used to make solar modules, also known as solar panels. The energy generated from these solar modules, referred to as solar power, is an example of solar energy. The photovoltaic effect was first recognized in 1839 by French physicist A.E. Becquerel. The first photovoltaic cell was built, by Charles Fritts, who coated the semiconductor selenium with an extremely thin layer of gold to form the junctions. The device was only around 1% efficient. Russell Ohl patented the modern junction semiconductor solar cell in 1946, which was discovered while working on the series of advances that would lead to the transistor. The modern photovoltaic cell was developed in 1954 at Bell Laboratories. The highly efficient solar cell was first developed by Daryl Chapin, Calvin Souther Fuller and Gerald Pearson in 1954 using a diffused silicon p-n junction. Another major change was the move to polycrystalline silicon. This material has less efficiency, but is less expensive to produce in bulk. Santosh Sreshta [6] in a detailed review gave a rigorous classification about research progress in the field of photovoltaics .

Efficiency

Commercially available solar cells have much more lower efficiencies. But nano technologically enhanced materials in which particle size approaches to zero, will enable a weight reduction accompanied by an increase in stability, improved functionality and efficiency and reduce the production cost. The efficiency of a solar cell may be broken down into reflectance efficiency, thermodynamic efficiency, charge carrier separation efficiency and conductive efficiency. The overall efficiency is the product of each of these individual efficiencies. Crystalline silicon devices are now approaching the theoretical limiting efficiency of 29%. Most commercially available solar cells are capable of producing electricity for at least twenty years without a significant decrease in efficiency. The typical warranty given by panel manufacturers is for a period of 25 – 30 years, wherein the output shall not fall below a specified percentage (around 80%) of the rated capacity. Materials for efficient solar cells must have characteristics matched to the spectrum of available light. Light absorbing materials can often be used in multiple physical configurations to take advantage of different light absorption and charge separation mechanisms. Materials presently used for photovoltaic solar cells include mono crystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium selenide/ sulphide. Many currently available solar cells are made from bulk materials that are cut into wafers between 180 to 240 micrometers thick that are then processed like other semiconductors. The latest invention is conducting polymers which are found to give conversion efficiencies of far greater than 15 %. Other materials are made as thin-films layers, organic dyes, and organic polymers that are deposited on supporting substrates. A third group are made from nano crystals and used as quantum dots (electron-confined nano particles).

Literature reveals that the energy costs associated with separating tightly bound excitons (photoinduced electron-hole pairs) and extracting free charges from highly disordered low-mobility networks represent fundamental losses for many low-cost photovoltaic technologies. A low cost, solution processable solar cell, based on highly crystalline Perovskite absorber with intense visible to near infrared absorptive, that has a power conversion efficiency of 10.9% in a single junction device under simulated full Sun light had been produced[7]. The first generation solar cells were based on Si wafers, mainly single crystals. Researches on cost reduction and improved solar cell efficiency have led to the marketing of solar modules having 12–16% solar conversion efficiency. Application of polycrystalline Si and other forms of Si have reduced the cost but at the expense of the solar conversion efficiency. The second generation solar cells were based on thin film technology. Thin films of amorphous Si, CIS (copper–indium–selenide) and tSi were employed. Solar conversion efficiencies of about 12% have been achieved with a remarkable cost reduction. The third generation solar cells are based on nano-crystals and nano-porous materials. An advanced photovoltaic cell, originally developed for satellites with solar conversion efficiency of 37.3%, based on concentration of the solar spectrum was developed. It is based on extremely thin concentration cells.

IV. Review of Literature

Spinel ferrites exhibit intelligent application of quantum mechanisms in the design of photovoltaic materials. This study examines solar cell research in India as revealed by the publications indexed in Web of science for a period of 20 years from 1991-2010. India, a leader in wind power generation is a densely populated country with high solar insolation. Thus it has an ideal combination for using solar power. In the solar energy sector, some large projects have been proposed, and a 35,000 km^2 area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 GW to 2,100 GW. In July 2009, India unveiled a US$19 billion plan to produce 20 GW of solar power by 2020. Under the plan, the use of solar-powered equipment and applications would be made compulsory in all government buildings, as well as hospitals and hotels. Also, India was ready to launch its National Solar Mission under the National Action Plan on Climate Change, with plans to generate 1,000 MW of power by 2013. Over the past six years, energy use by these centers and their supporting infrastructure is estimated to have increased by nearly 100 percent. If data centre energy demand continues to grow at the current rate there will be need to build approximately two large power plants per year to meet the demand. Just one 500-MW plant can cost $1.5 billion or more, depending on the technology. This power demand raises energy costs for business and government, strains the existing power grid, and can increase greenhouse gas emissions.

CSIR-NPL is the first laboratory to demonstrate the complete process 'from metallurgical grade silicon to solar grade poly silicon, fabrication of solar cells and currently it is actively involved in CSIR Energy Program 'Technologies And Products for Solar Energy Utilization through Networks (TAPSUN)' for the improvement of silicon solar cell efficiency to make silicon photovoltaic economically viable. Besides, the group is also involved in test and measurement of the photovoltaic devices. It has expertise and knowledge in fabrication, measurements, characterization, and theory to support photovoltaic research and development. The Interdisciplinary Centre for Energy Research **(ICER)** was set up in 2012 meant for research on various fields such as Concentrating Solar Power (CSP), Next-Generation Solar Photovoltaic's (PV), High Storage Density Battery, Green Buildings, Sustainable Technologies, Combustion Science and Technology. Photovoltaic research at the National Renewable Energy Laboratory (NREL) focuses on boosting solar cell conversion efficiencies, improving the reliability of PV components and systems. NREL's PV effort contributes to these goals through high-impact successes in fundamental research, advanced materials and devices, and technology development.

The EU (Energy Union) has supported PV research and development over 30 years. Since 2002 , a diverse range of technologies in research including Crystalline silicon cells, Thin-film cells, Organic and Dye-sensitised solar cells, Concentration photovoltaics, Novel concepts for photovoltaics, Conducting polymers (CPs) have been widely studied. Advanced technologies in various areas such as chemical and biosensors, catalysts, photovoltaic cells, batteries, super capacitors and others are realized. In particular, hybridization of CPs with inorganic species has allowed the production of promising functional materials with improved performance in various applications. Consequently, many important studies on CPs have been carried out over the last decade, and numerous researchers remain attracted to CPs from a technological perspective. The demand of energy consumption is increasing worldwide. As per estimate, it rises to 100% in the coming decades due to population growth. But the energy resources are very limited and living standards are becoming high besides industrialization. Therefore, the exploration of new energy-harvesting processes is required in clean energy applications such as solar cells [8-14]. Recent advances in energy storage may be attributed to energy applications of nanotechnology in which storage, conversion, manufacturing improvements by reducing materials and process rates, energy saving and enhanced renewable energy sources can be related. The most promising application of nanotechnology is solar cells [15, 16, and 17].The term molecular electronics is generally applied to devices designed to involve either a single molecule or a single layer of molecules oriented between two contacts with the critical distance between the contacts lying in the nano meter size range. Molecules have been experimentally demonstrated to work as switches, molecular wires or rectifiers; A new field is available for exploration due to the understanding of electron transport through single entities or assemblies of molecules. Around the globe work on molecular spintronics, vibronic effects, excitation of the molecular Junction with polarized light, quantum interference and decoherence, molecular chirality, molecular stretching and distortion as well as on thermoelectric response in molecular junctions is very actively pursued leading to the development of technology approaches practical problems including solar-energy harvesting, thermoelectricity, catalysis, sensing, and environmental issues [18,19]. The study of single-molecule junctions enormously contributes an understanding and control over the electronic transport phenomena at the molecular level [20-30]. The solar cells have layers of several different semiconducting materials stacked together to absorb light at different energies. Commercially available solar cells have much more lower efficiencies. With, Nanotechnology, Particle size approaches to nano range. Such Nano technologically enhanced materials will enable a weight reduction accompanied by an increase in stability and improved functionality. Hafnium diselenide (HfSe2) crystalline nano flakes exhibits an n-type semiconductor behavior with a high on/off current ratio exceeding 7.5 x 10 6. Attempts to find an alternative for this would be fruitful with III-V Semiconductor doped Nano ferrites, and a Nano composite incorporating it. Due to relatively poor light absorption of thin-films, more efficient light trapping mechanisms are required for better performance. Nano particles are especially relevant for energy sector because of their specific properties especially in energy transformation /conversion /production. In this higher absorption rates for light in solar cells can be tuned by the dimension of the absorbing nano particles. Nano materials are presently being attempted for commercial use in the application of the field of solar cells. There is an urgent need to develop nano materials in order to overcome 1) the Production cost 2) to improve the efficiency 3) degree of reliability 4) toxicity. In several countries around the globe the nano materials used in solar cells are targets for the technological Development and are attracting widely all the disciplines of research. Solar cells can be used for low power devices. But the crux of the task is making electrical contacts with the electrodes. Several Excellent Reviews on this topic have been published [31-35]. A low cost, but reasonably efficient (low power) solar cell would have tremendous impact on society. It would help preserve the environment, protect soldiers, provide rural areas with electricity, and transform the electronics industry. These dramatic effects, which would all be a result of nanotechnology, are already put to use in the developed countries leading to a great change in the day to day life of a human being and brought enormous improvement in the society.

The solar cells will be interesting for the local energy supply if the cost can be significantly reduced and the electrical energy can be efficiently saved. The reduction in cost can be achieved by using thin layer of active material on a cheap substrate in dye solar cells and the organic polymer solar cells. Semitransparent Organic Photovoltaic (OPV) cells [36] promise applications in various transparent devices, such as windows and translucentroof tops. A hurdle to commercial viability is the production of large-area modules that maintain high operation voltage to power output loads. Up scaling causes an inevitable decrease due to an increase of dead area, which does not contribute to the current generation, and due to resistance losses from interconnections. Christoph J. Brabec, Friedrich-Alexander University of Erlangen-Nuremberg, Germany, and colleagues overcame these obstacles by using silver nano wires as top electrodes in combination with ultrafast laser patterning and accurate positioning. This allows monolithic series-interconnections between individual modules, resulting in low-resistance contact of the interconnections as well as a reduced dead area. The cost can be reduced by using thin layer of active material on a cheap substrate. In organic cells and dye sensitized solar cells, single sensitizing dye can be used in the design that can be embedded in an electrode to increase the efficiency of the cell. By applying thin films which have low defect density and high level of crystallinity, the efficiency of solar cell can be increased. The absorption rates for light in solar cells can be increased by tuning the spectral absorption of light by the dimension of the absorbing nano particles. By replacing liquid electrolyte with a conducting polymer or inorganic material i.e. using solid electrolyte absorption rate can be increased.

In general, the nano materials were prepared by using micro-oven synthesis method [37, 38]. However the basic Characterizations of the materials demand homogenous materials which can be synthesized using a reliable Sol gel technique that requires reasonably simpler apparatus available in a good engineering college. Microwave assisted synthesis methods are extensively applied for the preparation of nano structured metal oxides. Microwave is electromagnetic radiation with frequency range of 0.3–300 GHz and corresponding wavelengths from 1 mm to 1 m. Due to the properties of internal and volumetric heating, thermal gradients during microwave processing are avoided, providing a uniform environment for reaction. This method has been successfully applied for the preparation of a variety of nano sized materials. Compared with conventional heating, microwave heating has an advantage of high-efficiency and rapid formation of nano particles with a narrow size distribution and no serious agglomeration. The use of microwaves as the heating source may offer benefits in terms of cost savings through the reduction in processing time and energy input and may result in improved yields of target compounds. This microwave synthesis method is simpler because of elimination of filtration, washing, calcinations etc. when compared to other methods. These two novel methods will be used in the present investigation for the preparation of nano particles for the application of solar cells.

New sensitizer or semiconductor systems are necessary to broaden the photo-response in solar spectrum. Hybrids of solar and conventional devices may provide an interim benefit in seeking economically valuable devices. New quantum dot solar cells based on CdSe–TiO2 architecture have been developed [39]. Magnetic properties of $Bi_{1-x}M_xFeO_3$ (M=Mg, Al, Y) ceramic materials synthesized by sol method were studied by SQUID measurements and their optical properties are determined by Diffused Reflectance Technique. The low band gap nature of these materials enabled them to exhibit photo catalytic activity [40].

L. A. Dobrzanski et.al,[41] presented a conventional technological process by means of screen printed method of monocrystalline silicon solar cells production to obtain a device producing an electrical energy, solar cells were connected in a photovoltaic module.Thin film photovoltaics (PV) relies on characterizing the optoelectronic and structural properties of each layer and correlating these properties with device performance [42]. Structural and optical models have been developed for the back reflector (BR) structure consisting of sputtered undoped zinc oxide (ZnO) on top of silver (Ag) coated glass substrates.The opportunity for substantial efficiency enhancements of thin film hydrogenated amorphous silicon (a-Si:H) solar photovoltaic (PV) cells using plasmonic absorbers requires ultra-thin transparent conducting oxide top electrodes with low resistivity and high transmittances in the visible range of the electromagnetic spectrum. Fabricating ultra-thin indium tin oxide (ITO) films (sub-50 nm) using conventional methods has presented a number of challenges; however, a novel method involving chemical shaving of thicker (greater than 80 nm) RF sputter deposited high-quality ITO films has been demonstrated [43]. The trade-off between transmittance and conductivity of the front contact material poses a bottleneck for thin film solar panels. Normally, the front contact material is a metal oxide and the optimal cell configuration and panel efficiency were determined for various band gap materials, representing Cu(In,Ga)Se2 (CIGS), CdTe and high band gap perovskites[44].

Organic photovoltaics (OPVs) are fabricated with blended active layers of Polymer molecules [45]. Genarally spin coating techniques of additives like 1, 8-Diiodooctane (DIO) and polystyrene(PS)with different concentrations influence photovoltaic parameters, such as fill factor, short circuit current density, and power conversion efficiency. The absorption and surface morphology of the active layers are investigated by UV-visible spectroscopy, atomic force microscopy (AFM) respectively. In Dyesensitized solar cells Terpyridine and quaterpyridine-based complexes allow wide light harvesting of the solar spectrum. Terpyridines with respect to bipyridines allow for achieving metal-complexes with lower band gaps in the metal-to-ligandtransition (MLCT), thus providing a better absorption at lower energy wavelengths resulting in an enhancement of the solar light-harvesting ability[46]. Inorganic-organic hydride perovskites bring the hope for fabricating low-cost and large-scale solar cells [47]. At the beginning of the research, two open questions were raised: the hysteresis effect and the role of chloride. The presence of chloride significantly improves the crystallization and charge transfer property of the perovskite. However, though the long held debate over of the existence of chloride in the perovskite seems to have now come to a conclusion, no prior work has been carried out focusing on the role of chloride on the electronic performance and the crystallization of the perovskite.To increase the photovoltaic conversion efficiency of solar cells, zinc oxide (ZnO) nano rods with various lengths were deposited on ZnO:Al (AZO)-coated glass substrates by using a solution phase deposition method; these Nano rods were prepared for application as working electrodes. The results indicated that when the lengths of the ZnO Nano rods increased, the adsorption of D-719 dyes through the ZnO NRs increased along with enhancing the short-circuit photocurrent and open-circuit voltage of the cell [48].The effect of adding reduced erbium-doped ceria nano particles as a coating on silicon solar cells is also reported in literature. Reduced ceria nano particles doped with erbium have the advantages of both improving conductivity and optical conversion of solar cells. When coating reduced erbium-doped ceria nano particles on the back side of a solar cell, a promising improvement in the solar cell efficiency has been observed from 15% to 16.5% due to the mutual limpact of improved electric conductivity and multi-optical conversions. Finally, the impact of the added coater on the electric field distribution inside the solar cell has been studied [49].

The effect of inserting 40 InAs/InGaAs/GaAs Quantum Dots layers in the intrinsic region of the heterojunction pin-GaAs/n+-Si was evaluated using photocurrent spectroscopy. The results reveal the clear contribution of the QDs layers to the improvement of the spectral response up to 1200 nm. The novel structure has been studied by X ray diffraction (XRD), Photoluminescence spectroscopy and Transmission Electron Microscopy (TEM). These results provide considerable insights into low cost III-V material-based solar cell [50]. Sudha Mokkapati et.al. [51] reviewed III-V compound Semi-Conductors for their major applications of InP/GaAs in optoelectronic devices. GaN based compounds are extremely important for short wavelength light emitters used in solid state lighting devices.Nano composites incorporating III-V doped ferrites are already under investigation [52-54] and emerging with important applications piercing through all the disciplines of knowledge, leading to industrial and technological growth. Nanotechnology is already having its impact on products as diverse as novel foods, medical devices, chemical coatings, photoluminiscent devices, EMI shielding tools in Defence, personal health testing kits, sensors for security systems and in Medical Theranostics, water purification units for manned space craft, displays for hand-held computer games, and high-resolution cinema screens etc. The 2014 Nobel Prize winners Isamu Akasaki, Hiroshi Amano and Shuji Nakamura used GaN as the base for the Material development of the LEDs that produce blue radiation.

Recently I. Rajani et.al, [55] presented experimental analysis of results of GaN (being a III-V semiconductor) doped with Ferrite elements synthesized using Sol-Gel technique. The experiment was carried out at National Chemical Laboratory, Pune Maharashtra. The GaN is employed as dopant for x=1 and x=5, in the formula Ga(2x) N Fe2(49-x) O3 . The XRD (Structural), SEM (Morphological) and FTIR spectroscopic studies were carried out to confirm the size, type of bonding and study the surface between the compounds and reported results that were in good agreement with the literature. In a later communication[56] further Morphological, structural and Thermal characterization studies were reported from Transmission Electron Microscopy, Energy Dispersive X-ray Analysis, Selected Area Electron Diffraction, Thermo-Gravimetric Analysis and Differential Thermal Analysis were also reported by them. They observed in their studies that the particles possess Cylindrical and the Globular structures. The particle diameter values from the Histograms (using IMAGE-J software) showed good agreement with the XRD values that were earlier reported by them. The SAED and the EDAX studies revealed the confirmation of the composition and also that the synthesized Ferrite exhibits crystalline nature. The TG-DTA results show that the compound indicates constant sample weight. I.Rajani et.al,[57] also reported Similar results for Ga(2x) N Fe2(49-x) O3 for (x=0.5 and x=0.75).The morphological and energy-dispersive X-ray analysis and the Infrared studies confirmed the composition of the material and the particle sizes of the samples are found to be in the range of 9–27 nm (for x = 0.5) and 23–30nm (for x = 0.75). The particle sizes, obtained from the histogram evaluations, the Debye–Scherrer formula in X-ray diffraction and the selected area electron diffraction measurements are all in good agreement. Further the room temperature magnetic measurements obtained using the Vibration Sample Magnetometer (for x = 0.5, 0.75, 1and 5) were presented as the hysteresis curves and their related plots.The discussion about the conclusions drawn therein infrared that the coercivity increased with the concentration. The compound exhibited spinel structure and vivid changes from the super paramagnetic to the ferromagnetic state.

V. Conclusion

The demand of energy consumption is increasing worldwide. As per estimate, it will go up by 100% in the next few decades due to population growth, the limited energy resources, and high living standard besides industrialization. Therefore, the exploration of new energy-harvesting processes is required in clean energy applications such as solar cells. In the light of work reported by Sudha Mokkapati et.al. andI. Rajani et.al, the authors took up the study of Nanomaterials incorporating the III-Nitride and III-V semiconducting materials and the corresponding Nano-composites obtained by the impregnation of these doped ferrites that are possessing a lot of latent potential. They are yet to be properly developed into suitable tools for the photovoltaic applications, especially using Photoelectron Spectroscopy and X-ray Magnetic Circular Dichroism and other Bandgap Engineering studies to understand the conversion efficiency of the optical energy to electrical energy and the magnetic behavior.This review tries to emphasize the various practices and methods to promote the benefits of solar energy. Nanotechnology in the form of might be able to increase the efficiency of solar cells, but most promising application of nanotechnology is the reduction of manufacturing cost. Inexpensive solar cells, which would utilize nanotechnology, would help preserve the environment. Even though their efficiency is not very great, if solar cells were inexpensive, then enough of them could be used to generate sufficient electricity.

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