A Review on Perovskite Solar cells

Umesh Kumar Singh
Faculty of Engineering, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

ABSTRACT: Perovskite Solar Cells (PSCs) have commanded the notice of the analysts overall inferable from their exceptional Photovoltaic (PV) execution. PSCs are the fate of the PV innovation as they are fit for creating power with execution being tantamount with the main Silicon sun oriented cells, with the expense being lower than Silicon sun based cells. The gigantic capability of PSCs is clear from the way that the effectiveness of these cells has ascended from 3.8% to 25.2% inside 10 years, and it is ceaselessly ascending to date. We talk about the highlights making PSCs better than contemporary PV innovations. The depiction of the advancement of proficiency and different models used to date has been introduced. The perovskite film manufacture methods with some enormous scope perovskite sun powered cell producing methods are examined. Regardless of positive attributes, the PSCs have confronted a few issues, for example, debasement within the sight of dampness, oxygen, and UV, harmfulness, and so forth the effect of these variables with different cures embraced by specialists has been examined. In any case, the unsteadiness issue raised by poisonousness isn't of much concern is upheld in this paper. These issues making snags in the way of commercialization of PSCs alongside the commercialization guide are examined altogether.

KEYWORDS: Solar cell, Efficiency, Pervoskite, Silicon

INTRODUCTION

Perovskites are a class of materials that share a similar structure, which display a myriad of exciting properties like superconductivity, magnetoresistance and more. These easily synthesized materials are considered the future of solar cells, as their distinctive structure makes them perfect for enabling low-cost, efficient photovoltaics. They are also predicted to play a role in next-gen electric vehicle batteries, sensors, lasers and much more.

In general, Photovoltaic (PV) technologies can be viewed as divided into two main categories: wafer-based PV (also called 1st generation PVs) and thin-film cell PVs. Traditional crystalline silicon (c-Si) cells (both single crystalline silicon and multi-crystalline silicon) and gallium arsenide (GaAs) cells belong to the wafer-based PVs, with c-Si cells dominating the current PV market (about 90% market share) and GaAs exhibiting the highest efficiency.

Thin-film cells normally absorb light more efficiently than silicon, allowing the use of extremely thin films. Cadmium telluride (CdTe) technology has been successfully commercialized, with more than 20% cell efficiency and 17.5% module efficiency record and such cells currently hold about 5% of the total market. Other commercial thin-film technologies include hydrogenated amorphous silicon (a-Si:H) and copper indium gallium (di)selenide (CIGS) cells, taking approximately 2% market share each today. Copper zinc tin sulphide technology has been under R&D for years and will probably require some time until actual commercialization.

An emerging thin-film PV class is being formed, also called 3rd generation PVs, which refers to PVs using technologies that have the potential to overcome current efficiency and performance limits or are based on novel materials. This 3rd generation of PVs includes DSSC, organic photovoltaic (OPV), quantum dot (QD) PV and perovskite PV.

For last such countless years, the humanity has been searching for a wellspring of energy that isn't just naturally supportable yet is financially practical also. Current worldwide force request is about 16TW, and it is assessed that the force request would increment past 30TW by 2050. In this way, thorough exploration is being completed to get a productive force age framework, as the conventional method of consuming petroleum derivative would not have the option to meet the climb in the force necessity[1]. The sustainable power sources, for example, flowing, aqueous, geothermal, wind, sun oriented, and so on will go about as a deliverer in the energy emergencies. Among the different wellsprings of energy, sunlight based energy is accepted to be the most encouraging and proficient one because of its accessibility in wealth. The uniqueness of sun powered energy can likewise be induced from the way that 60 minutes of nonstop light of sun

based energy is fit for satisfying our yearly force requests, if all the episode sun based energy is changed over into power[2]. In this way, utilizing PV sun based cells for power age is by all accounts a promising route as they convert the daylight straightforwardly into power. In 1839, Edmund Becquerel was the first to change over daylight into power. In 1873, Willoughby Smith found photoconductivity (PC) in selenium. In 1883, Charles Fritts proposed the main plan of PV cell, which depended on the Selenium wafers. The hypothesis of photoelectric impact proposed by Albert Einstein in 1905 clarified how light takes out the electron from the metal surface. Later for this work, he was granted with the Nobel Prize. In 1918, Jan Czochralski laid the establishment of Silicon (Si) based sun based cells by building up a procedure to develop single-precious stone silicon (Si) (The History of Solar Energy, 2013)[3]. In 1954, the introduction of PV happened, when the glasslike silicon-based sunlight based cell was created in Bell lab, USA that had power change productivity (PCE) of 4.5% (Chapin et al., 1954). From that point forward, analysts have been effectively looking for an ease gadget structure and some new materials showing the PV impact. Accordingly, second-age sun based cells appeared[4]. These phones were fundamentally founded on III-V gadget structure, GaAs, CdTe, INP, and CIGs sunlight based cells were presented in the field of sunlight based photovoltaic (Green et al., 2018). The mid 1990s thought of the third era of sun oriented cells with Dye-sharpened structure. In 2000s Organic Photovoltaic cells (OPV) were presented. With developing interest in nano materials, concentrated exploration work is being completed for finding new materials in the field of sunlight based gadgets, which are modest as well as requires minimal effort handling conditions as well. Right now, glasslike silicon sun oriented cells rule the market, yet the elements, for example, the necessity of the costly assembling measure and exorbitant crude materials are asking analysts to think of another PV innovation that has the blend of both high proficiency furthermore, minimal effort producing[5].

REVIEW OF LITERATURE

There have been many paper published in the field of solar panel materials among all the papers a paper titled “A review on perovskite solar cells: Evolution of architecture, fabrication techniques, commercialization issues and status” by Priyanka Roya , Numeshwar Kumar Sinhaa , Sanjay Tiwarib , Ayush Kharea discusses For last such countless years, the humankind has been searching for a wellspring of energy that isn't just ecologically maintainable however is economically feasible too. Current worldwide force request is about 16TW, and it is assessed that the force request would increment past 30TW by 2050. In this way, thorough exploration is being done to get a proficient force age framework, as the conventional strategy of consuming non-renewable energy source would not have the option to meet the climb in the force prerequisite. The sustainable power sources, for example, flowing, aqueous, geothermal, wind, sun powered, and so forth will go about as a hero in the energy emergencies. Among the different wellsprings of energy, sun oriented energy is accepted to be the most encouraging and proficient one because of its accessibility in bounty. The uniqueness of sun oriented energy can likewise be surmised from the way that 60 minutes of consistent enlightenment of sun powered energy is equipped for satisfying our yearly force requests, if all the occurrence sun powered energy is changed over into power. Thus, utilizing PV sun oriented cells for power age is by all accounts a promising path as they convert the daylight straightforwardly into power[6].

In 1991, inspired by the principle of photosynthesis, O’Regan and Gratzel reported a landmark construction of solar cell called dye-sensitized solar cell, which can cover the sun light energy into electricity energy with an efficiency about 7%[7]. Presenting numerous advantages such as abundant raw materials, facile processing, and low cost compared with conventional solar cells, these novel solar cells made itself investigated popularly rapidly after its arising. And it is this work that inspired the emergence of PSCs, a DSSC with perovskite compounds

CONCLUSION

Perovskite Solar Cells (PSCs) have grabbed the attention of the researchers worldwide owing to their outstanding Photovoltaic (PV) performance. PSCs are the future of the PV technology as

they are capable of generating power with performance being comparable with the leading Silicon solar cells, with the cost being lower than Silicon solar cells. The enormous potential of PSCs is evident from the fact that the efficiency of these cells has risen from 3.8% to 25.2% within a decade, and it is continuously rising to date. We discuss the features making PSCs superior to contemporary PV technologies. The description of the evolution of efficiency and various architectures used to date has been presented. The perovskite film fabrication techniques with some large scale perovskite solar cell manufacturing techniques are discussed. Despite positive traits, the PSCs have faced some issues, such as degradation in the presence of moisture, oxygen, and UV, toxicity, etc. The impact of these factors with various remedies adopted by researchers has been discussed. However, the instability issue raised by toxicity is not of much concern is supported in this paper. These issues creating obstacles in the path of commercialization of PSCs along with the commercialization road map are discussed thoroughly[8].

REFERENCES

[1] N. G. Park, "Perovskite solar cells: An emerging photovoltaic technology," *Materials Today*. 2015, doi: 10.1016/j.mattod.2014.07.007.

[2] H. Zhou *et al.*, "Interface engineering of highly efficient perovskite solar cells," *Science (80-.).*, 2014, doi: 10.1126/science.1254050.

[3] M. A. Green, A. Ho-Baillie, and H. J. Snaith, "The emergence of perovskite solar cells," *Nature Photonics*. 2014, doi: 10.1038/nphoton.2014.134.

[4] H. S. Jung and N. G. Park, "Perovskite solar cells: From materials to devices," *Small*. 2015, doi: 10.1002/smll.201402767.

[5] T. Leijtens, G. E. Eperon, N. K. Noel, S. N. Habisreutinger, A. Petrozza, and H. J. Snaith, "Stability of metal halide perovskite solar cells," *Adv. Energy Mater.*, 2015, doi: 10.1002/aenm.201500963.

[6] J. Li, Q. Wang, and A. Abate, "Perovskite solar cells," in *Nanomaterials for Solar Cell Applications*, 2019.

[7] B. O'Regan and M. Grätzel, "A low-cost, high-efficiency solar cell based on dye-sensitized colloidal TiO2 films," *Nature*, 1991, doi: 10.1038/353737a0.

[8] C. Zuo, H. J. Bolink, H. Han, J. Huang, D. Cahen, and L. Ding, "Advances in perovskite solar cells," *Advanced Science*. 2016, doi: 10.1002/advs.201500324.