International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Forming of Room Ambient PSS Cell Using F-127 With PVA Blend as a Hole Transport Material

Supriya Dhumal[1], Dr. C. G. Dighavkar[2], Arun Patil[3], Pramod K. Singh[4], Nitin Jadhav[5]

[1,2,3]L. V. H. College, panchavati, Nashik(M.S.), India
[4]Center of Excellence on Soar cells and Renewable Energy, Department of physics, School of Basic Sciences and Research, Sharda university, Greater Noida, UP 201310, India
[5]Vidhya pratishthan's kamalnayan bajaj institute of Engineering and Technology, Baramati, India

Abstract :
In the present wok we have focused on the synthesis and characterization of perovskite material using solid polymer electrolyte, based on PVA and F-127 blend. We studied detail information about perovskite material, methods as well as its characteristics detail in this paper. We revealed the data by XRD, SEM and UV absorption spectroscopy which was closely connected with the dielectric parameters. We successfully synthesized and tested $CH_3NH_3PbI_3$ perovskite material. The XRD pattern conforms that the pure perovskite material is formed. From SEM image we defiantly say that the formed material is crystalline structure. The find out the perovskite material band gap was 2.36 eV using UV.

Keywords: PVA; KI and I2; solid polymer.

Introduction

Solar cells, also called photovoltaic (PV) cells are devices which transfer sunlight into electricity using the photovoltaic effect and supply a clean energy generation option. The modern era of photovoltaic began, when the first solar cell was developed by Chapin et al in 1954 which was based on silicon wafers form crystals, he denoted that under sunlight, p-n junction diodes generated some voltage . The solar cell action begins by the lighting of the sunlight, on a p-n junction by which the electron-hole pairs are produced, which are detached by the built-in electric area across the p-njunction's depletion region. This separation of the charges generates a PV across the p-n junction leading to electrical current when connected externally by a load. Photovoltaic power can be produced using solar panel fabricated with large amount of solar cells which are composed of photovoltaic material. Mono-amorphous silicon, crystalline silicon, polycrystalline silicon, cadmium telluride, Number of solar cells when joint together it forms solar module, by merging these module the photovoltaic panel or array can be produced. Generally these photovoltaic panels gives direct current (DC) which can be transfer to alternating current (AC) by connecting photovoltaic array to inverter, also for practical purposes many instruments need alternating current. Space satellites and smaller items like streetlight and battery are powered by solar cells. Also these days lots of people use PV at their homes and businesses. Some companies also use photovoltaic technologies for their power stations.

2. MATERIALS AND METHODS

2.1 Materials

We are using distinct materials for reparation of perovskite solar cell i.e. DMF which is used as solvent for PbI2,while Ti(IV) used as a blocking layer solution, lead iodide (PbI2) and H2-PtCl6. Methylamine and Hydro iodic acid (HI, 57 wt% in water) used directly, ethanol used as solvent for F-127 and I2 and diethyl ether used for remove impurities from precursor material. TiO2 pest. The FTO and platinum used as working electrode and counter electrode with dimension 20 mm * 20 mm resistivity near about 8 to 9Ώsq.

2.2Composition of perovskite material

CH_3NH_2 put into round bottom flask, and this flask placed into the ice bath for 0^0 C.then add HI (hydro iodic acid) drop by drop into the Methylamine. Maintain temperature of methylamine at 0^0C while mixing HI. While doing this,stir the mixture continuously for 2 hours. After that keep the prepared mixture in an oil bath for 1 hour to heat at 80^0 C. after keeping inoil bath for 1 hour, its white colour powder is formed. After getting the white colour powder, wash the powder in diethyl ether 2 to 3 times. Then next put this powder into the vacuum oven at 120^0 C for 20min for drying. After all this process we get the final product of CH_3HN_3 I. CH3NH3I powder and PbI_2 were mixed in 2ml of DMF liquid as 1:1 molar ratio and sterilized for 2 hours so we get the CH3NH3PbI3 final product.Then, the tincture was dreged on the substrate, with a spin coater and make it warm up to 90^o for 10minutes.

2.3 Makingprocesses of solid polymer electrolyte :

To make a solid polymer, PVA, F-127 and I_2 were initially measured and mixed together using a magnetic stirrer. Initially we take 60:40 ratio for the f-127 and PVA. initially three beaker were taken, one beaker contained PVA, second beaker f-127 and in the third beaker I_2.Put PVA direct into the oven at 130^o c for 20 to 25 minutes to melt. Also both f-127 and iodine were dissolved in methanol at room temperature. After melting the PVA take it out from oven and place it on magnetic stirrer and add F-127 and I_2 one after another. All the three mixture were properly and preserved stirring for 1hour. Then it was poured into a petri dish and dried for 24 hours, thus in 24 hours we got solid polymer film.

2.4 Making processes of perovskite sensitized solar cell

FTO was used as a substrate to make perovskite sensitized solar cell. We started depositing chemical Ti(IV) bis(acetoacetato)-diisopropoxide used as blocking layer of on FTO and it was put it an oven at 500^oC for 20min to be annealed. Mesoporous TiO2 paste is layered on FTO substrate over Ti(IV) bis(acetoacetato)-diisopropoxide layer. The coated substrate TiO2 was sintered for 45mins at 510ºC and cool down at normal temperature. To deposit the TiO2 paste on substrate used doctor blade method. To maintaining the ~10µm thickness of tio2 layer using adhesive blade[6]. The WE was used as sensitized with CH3NH3PbI3 perovskite material using spin coating method. To removing impurity washed with acetone. For preparing counter electrode another FTO coat with H2PtCl6 solution, followed by heating at 420 ºC for 20 minutes.Counter electrode have a coating with solid polymer electrolyte solution, which consisting of PVA : KI (f-127 is 10% of PVA) and I2 (10% of KI). Methanol was used as solvent for this preparation. PSSC made up of sandwich of working electrode and counter electrode and the performance of PSSC analysed at normal temperature.

3. Result and discussions

3.1 UV absorption

Band gap of perovskite material observed and studied by using UV – visible spectroscopy. CH3NH3PbI3 UV-visible absorption was measured by UV spectrometer. As shown in fig1 we clearly seen that band gap (E_g) is 2.36eV. Transform Kubelka-Munk function formula (i) which is related to the optical band gap energy.

$$[F(R)h\upsilon]1/p = A(h\upsilon - Eg) \quad \textbf{(i)}$$

Here, A and P are the constant and index respectively related with optical absorption.
Probably P equals to two or **½.** For transfers approved indirectly or directly. As shown in the graph, we found the band gap of $CH_3NH_3PbI_3$ to be 2.36eV, this Bad gap has been reported in the previous work [7, 8].

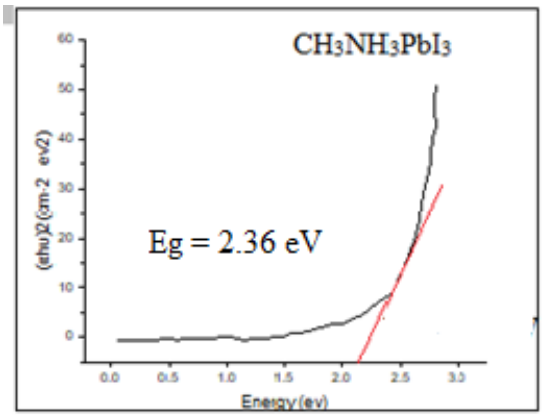

Fig. (1). Graphical presentation of Band gap analysis of $CH_3NH_3PbI_3$.

3.2 SEM Analysis :

We studied the surface morphology of the perovskite material (CH3NH3PbI3) using scanning electron microscopy as shown in fig 2. From fig. 2 we clearly seen that photo is not a homogeneous in nature. The collection of PbI2 and CH3NH3I material on the surface, So we can say that the structure clearly reveals the crystalline nature of that material[8, 9].

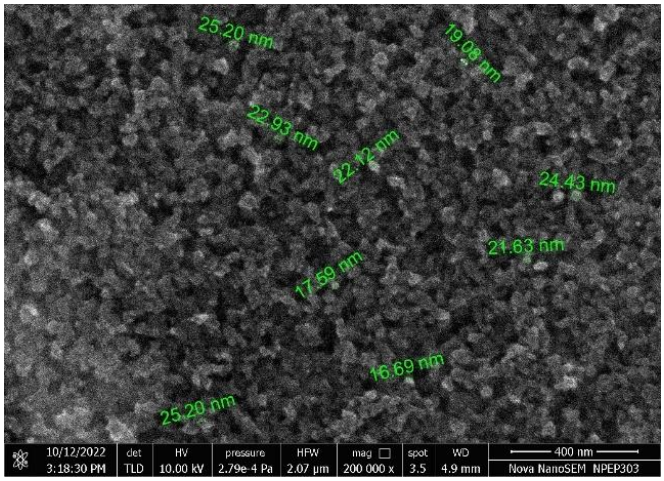

Fig. (2). SEM image of the perovskite material with grain size.

3.3 X-ray diffraction (XRD)

We looked at the XRD characteristics of the powder perovskite material from which we understand that the material is crystalline. XRD characteristics will be seen through XRD machine and grain size of material will be calculated according to bragg's formula.

$$2d\sin\theta = n\lambda \qquad \text{(ii)}$$

Here all parameters are equal as per braggs formula,

n = positive integer

λ = wavelength of incident wave

θ = scattering angle

d = inter planer distance

XRD data range were took from 20^o to 80^o scanning speed 2^o per mint.

From XRD pattern we say that prepared synthesized material of perovskite is orthorhombic ($a \neq b \neq c$, $\alpha = \beta = \gamma = 90^o$). The grain size of perovskite material calculated by formula given in equation (ii) is 48nm. As per literature our results are near about similar with this [8-11].

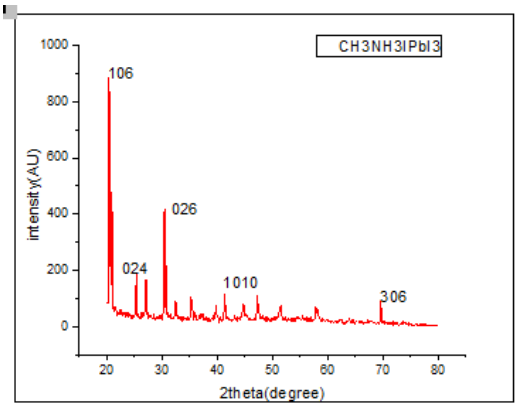

Fig. (3). XRD analysis of perovskite material.

4. Conclusion

We successfullysynthesized and tested $CH_3NH_3PbI_3$ perovskite material. The XRD pattern conforms that the pure perovskite material is formed. From SEM image we defiantly say that the formed material is crystalline structure. The find out the perovskite material bandgap was 2.36 eV using UV.

REFERENCES

1. Ma Yingzhuang,Wang Shufeng,Zheng Lingling, Zelin Lu, Zhang Danfei, RecentResearch Developments of Perovskite Solar Cells, Chin. J. Chem. 2014; 32: 957-963
2. Im Hyeok, Jang In-Hyuk, Norman Pellet, Grätzel Michael and Park N. G., Growth of CH3NH3PbI3 cuboids with controlled size for high-efficiency perovskite solar cells, Nature Nanotechnology 2014; 9: 927-932
3. Kojima A,Teshima K, Shirai Y, T. Miyasaka, Organometal halide perovskites as visible-light sensitizers for photovoltaic cells, J. Am. Chem. Soc. 2009; 131: 6050-6051.
4. ImJ. H. , Lee C.R., Lee J-W. , Park. S.W, Park N.G. , 6.5% efficient perovskite quantum-dot-sensitized solar cell, Nanoscale 2011; 3: 4088–4093

5. Kim Hu i-Seon, Lee Chang- Ryul, Hyeok Jeong-Im, Gra¨tzel ,Michael,Park Nam Gyu, All-Solid-State Submicron Thin FilmMesoscopic Solar Cell with Efficiency Exceeding 9%, Scientific Reports 2012; 2: 591
6. Singh R, Bhattacharya B., Rhee H. W., Singh PK, Solid gellan gum polymer electrolyte for energy application. International Journal of Hydrogen Energy 2015; 40: 9365-9372.
7. Park N. G. Perovskite, solar cells: an emerging photovoltaic technology, Materials Today. 2015; 18: 65-72
8. Kunwu Fu, SweeSien Lim, Modulating CH3NH3PbI3 Perovskite Crystallization Behavior Through Precursor Concentration, World Scientific Publishing Company, 2014; 5: 1440003 -1440012
9. ImJ. H., Perovskite solar cells with a planar heterojunction structure prepared using room-temperature solution processing techniques, Nanoscale, 2011; 3: 133-138
10. Thompson C.V., Direct Evidence for Effects of Grain Structure on Reversible Compressive Deposition Stresses in Polycrystalline Gold Films Annu. Rev. Mater. Sci. 2000; 30: 159.
11. Safdari Majid, Fischer Andreas, Xu Bo, Klooa Larsand Gardner James M. ,Structure and function relationships in alkylammonium ead(II) iodide solar cells. J. Mater. Chem. A, 2015; 3: 9201-9207.
12. Rahul, Bhattacharya B. , Singh K. Pramod , Singh Roja, Khan H. Zishan, Perovskite sensitized solar cell using solid polymer Electrolyte.International Journal of Hydrogen Energy 2016; 41: 2847-2852.
13. Hashmi, S. A., Kumar, A., Maurya, K. K., & Chandra, S. (1990). Proton-conducting polymer electrolyte: The polyethylene oxide + NH4CIO4 system. Journal of Physics D:Applied Physics, 23, 1307–1314.

    Kaneko, M., Hoshi, T., Kaburagi, Y., & Ueno, H. (2004). Solid type dye-sensitizedsolar cell using polysaccharide containing redox electrolyte solution. Journal ofElectroanalytical Chemistry, 572, 21–27.
14. Koh, J. C. H., Ahmad, Z. A., & Azmin, A. A. (2012). Bacto agar-based gel polymerelectrolyte. Ionics, 18, 359–364.
15. Kubo, W., Kitamura, T., Hanabusa, K., Wada, Y., & Yanagida, S. (2002). Quasi-solid state dye-sensitized solar cells using room temperature molten salts and a lowmolecular weight gelator. Chemical Communications, 374–375.
16. Kumar, M., Tiwari, T., & Srivastava, N. (2012). Electrical transport behaviour of biopolymer electrolyte system: Potato starch + ammonium iodide. CarbohydratePolymers, 88, 54–60.
17. Lenz, R. W.(1993). Biodegradable polymer. Advances in Polymer Science, 107,1–40.

    Nazeeruddin, M. K., Kay, A., Rodicio, I., Humphry-Baker, R., Müller, E., Liska, P.,et al. (1993). Conversion of light to electricity by cis-X2bis(2,2_-bipyridyl-4,4_-dicarboxylate)ruthenium(II) charge-transfer sensitizers (X = Cl−, Br−, I−, CN−,and SCN−) on nanocrystalline titanium dioxide electrodes. Journal of AmericanChemical Society, 115, 6382–6390.