Gurukul International Multidisciplinary Research Journal (GIMRJ)*with* International Impact Factor 8.357
Peer Reviewed Journal
https://doi.org/10.69758/GIMRJ/2505I5VXIIIP0032

e-ISSN No. 2394-8426
Monthly Issue
MAY-2025
Issue–V, Volume–XIII

A Review: New age of polymer based photovoltaic materials

D. J. Bhagat*[a], G. R. Dhokane[b]
[a]Department of Physics, Nehru Mahavidyalaya (Arts, Commerce & Science), Nerparsopant, Dist. Yavatmal.
[b]Department of Physics, Arts, Science and Commerce College, Chilkhaldara, Dist. Amravati.

Abstract:
This review article expresses the most demanding materials like polymer-based photovoltaic materials. Number researches was carried out to developed the photovoltaic materials. Among, these research polymers based photovoltaic materials is most recent research and highly efficient to convert solar energy into electricity. The researchers adopted number of synthesis methods to prepared polymers based photovoltaic materials and characterized through various characterization techniques such as XRD, FTIR, UV-Vis, SEM, TEM, AFM, EDS, EIS, Cyclic Voltammetry (CV), potentiostatic and galvanostatic conditions to confirm the successful synthesis of materials. Moreover, they discussed various properties and efficiency of synthesized materials.

Introduction:
In recent years, the fast-growing population and world economy, high requirements of electrical energy for houses, industry, offices, hotels and fuel for automobiles, etc are the reason for excessive use of energy sources. In future the non-renewable energy sources will be empty due this excessive use of energy. Also, the extraction of energy from the non-renewable energy sources makes a lot pollution which damage to environment as well as human and other animals. That's why, the renewable energy is best replacement to resolve the issue of energy requirement. Moreover, it is most eco-friendly, non-polluting energy source, easily available without any cost. Therefore, most of academic researchers, researchers as well as industrial researchers were focused to develop the photovoltaic materials which can directly convert solar energy into electricity. The most important fact is Other renewable energy sources like geothermal energy, hydro energy, ocean energy, wind energy, biomass energy has some limitations for the extraction of energy as well as availability. But Solar energy is easily available on any part of the earth as compared to other renewable energy sources. Therefore, solar energy is widely used as renewable energy source in last few decades and for the utilization of solar energy photovoltaic materials are very essential. The efficiency of solar cell is depending on the photovoltaic materials used to make it. So, till date various generation of solar cells are developed which are dependent on their efficiency and base materials used [1-5]. Thus, this review article discussed the new trend of polymer based photovoltaic materials.

Results and Discussions:

* Corresponding author: **bhagatd@rediffmail.com**

Most research has been done to developed the best photovoltaic materials for the application of solar cell. Some research on the polymer based solar cell is discussed here. Takpire et.al reported the optical and structural properties of PANi/Ti polymer composites for photovoltaic application with the help of XRD, FTIR, FESEM characterizations and found the power conversion efficiency of 0.411% [6]. Takpire et.al studied photovoltaic activity of Titanium-Doped Polythiophene Composites and reports the power conversion efficiency of 2.481% for the PV cell [7]. Takpire et.al demonstrated PV performance of PTh-co-PANi-Ti composites materials with power conversion efficiency 5.1% [8]. Li et.al developed the structure of indium tin oxide (ITO)/polymer blend/vanadium oxide/aluminum (Al) for the application of solar cell [9]. Wong et.al fabricated poly(3-hexylthiophene) (P3HT)/fullerene derivative based solar cells and found the power conversion efficiencies ranges over 4.4–5.0% [10]. Sun et.al synthesized low-cost polymer donor poly[(thiophene)-alt-(6,7-difluoro-2-(2-hexyldecyloxy)quinoxaline)] (PTQ10) with maximum yield of 87.4%. Moreover, power conversion efficiency of developed materials found to be 12.70% [11]. Some research has been done to make the photovoltaic materials using conducting polymers, copolymers and their derivatives to found some new and low-cost materials.

Conclusion:

Tremendous efficiency to convert solar energy into electricity reveal by the polymers, conducting polymers, copolymers and their metal oxide doped composites as well as nanocomposites, nanofibers based photovoltaic materials. The various polymers based photovoltaic materials are got incredible results showing maximum efficiency up to 12.7%.

References:

1) P. Gnida, M. F. Amin, A. K. Pajak, B. Jarzabek, Polymers in High-Efficiency Solar Cells: The Latest Report, Polymers 14, 2022.
2) A. Yelshibay, S. D. Bukari, B. Baptayev, M. P. Balanay, Organics 5, 2024.
3) Conducting Polymers in Solar Cells: Insights, Innovations, and Challenges, D. Zhao, M. Sexton, H. Y. Park, G. Baure, J. C. Nino, F. So, High-Efficiency Solution-Processed Planar Perovskite Solar Cells with a Polymer Hole Transport Layer, Adv. Energy Mater., 2014.
4) W. Hou, Y. Xiao, G. Han, J. Y. Lin, The Applications of Polymers in Solar Cells: A Review, Polymers 11, 2019.
5) S. H. Peng, T. W. Huang, G. Gollavelli, C. S. Hsu, Thiophene and diketopyrrolopyrrole based conjugated polymers as efficient alternatives for spiro-OMeTAD in perovskite solar cells as hole transporting layers, Journal of Materials Chemistry A, 2017.
6) S. R. Takpire, S. A. Waghuley, Investigating the optical and structural properties of PANi/Ti polymer composites for photovoltaic application, Journal of the Energy Institute 90(1), 2017.
7) S. R. Takpire, S. A. Waghuley, Photovoltaic Study of Chemically Derived Titanium-Doped Polythiophene Composites, Journal of Electronic Materials 44, 2015.

8) S. R. Takpire, K.R. Nemade, S. A. Waghuley, Further exploration of photovoltaic performance of polythiophene-co-polyaniline–Ti copolymer composites PV system, Materials Design 101, 2016.
9) G. Li, C.W. Chu, V. Shrotriya, J. Huang, Y. Yang, Efficient inverted polymer solar cells, Applied Physics Letter 88, 2006.
10) W. Y. Wong, X. Z. Wang, Z. He, A. B. Djurisic, C. T. Yip, K. Y. Cheung, H. Wang, C. S. K. Mak, W. K. Chan, Metallated conjugated polymers as a new avenue towards high-efficiency polymer solar cells, Nature Materials 6, 2007.
11) C. Sun, F. Pan, H. Bin, J. Zhang, L. Xue, B. Qiu, Z. Wei, Z. G. Zhang, Y. Li, A low cost and high-performance polymer donor material for polymer solar cells, Nature Communications 9, 2018.