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PEROVSKITE AS MATERIAL FOR THIRD GENERATION SOLAR CELLS

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ABSTRACT

Nowadays renewable energy source become important to achieve sustainable development goals (SDG) that have been focusing on increase the solar, wind and thermal energy. The emerging solar cell such as perovskite solar cell can of improving solar cell efficiency while simultaneously reducing manufacturing costs. Sustainable development goals (SDG) can be accomplishing using perovskite solar cell which ensuring access to affordable energy with some improvements in efficiency and manufacturing processes that made solar cells and panels more affordable and widely accessible.

KEYWORD

SDG, Perovskite solar cell, Power Conversion Efficiency

INTRODUCTION

There are 17 Goals as shown in Figure 1 created by United Nation which 193 countries involve and Malaysia is one of it involve in the year 1957. Sustainable development goals (SDG) are a call for action by all countries to promote prosperity while protecting the planet. The plan is to growth the economy and also taken care about social needs including health, education, social protection and job opportunities. Besides that, the climate changes, environmental protection also taken into consideration. As for renewable energy which involves SDG 7 that is ensuring access to clean and affordable energy, which is key to the development of agriculture, business, communications, education, healthcare and transportation. The target is by the 2030 all the country has an access to affordable electricity means investing in clean energy sources such as solar, wind and thermal. Nowadays solar energy becoming very important as to achieve SDG 7 that have been focusing on increase substantially the share of renewable energy in the global energy. Even in Malaysia shown with Malaysia Energy Commission's efforts to reach the 31% renewable energy capacity mix goal for Malaysia by 2025, there are plans to establish a combined 1,178MW of new renewable energy capacity in Peninsular Malaysia starting in 2021. This new capacity comprises 1,098MW from solar sources and 80MW from non-solar sources (Energy Commission of Malaysia, 2020)

Figure 1: 17 sustainable development goals by United Nation

PEROVSKITE SOLAR CELL (PSC)

The initial stage of solar cell development involved the utilization of wafer-based solar cells, which encompassed both monocrystalline and polycrystalline forms. However, these early solar cells faced a significant drawback due to their expensive production costs. Continuing research led to the development of the second generation of solar cells, which incorporated thin film technology utilizing materials like Copper Indium Gallium Selenide (CIGS), Amorphous Silicon, Cadmium Telluride (CdTe), or Cadmium Selenide (CdSe). Thin film technology offered the advantage of reduced manufacturing costs compared to traditional wafer-based cells. However, it was accompanied by a trade-off in terms of lower efficiency levels. Following the third generation of solar cells, there emerged a wave of technologies with the primary goal of improving solar cell efficiency while simultaneously reducing manufacturing costs. This generation witnessed the rise of promising technologies such as Dye Sensitized Solar Cells (DSSC) and Perovskite Solar Cells, which represent the forefront of emerging solar cell technology (Ali et al., 2021).

Perovskite materials have demonstrated significant potential in enhancing efficiency and performance in solar cells. One key advantage is their capability to absorb a broad spectrum of light wavelengths, encompassing visible and near-infrared light, thereby facilitating improved light harvesting shown in Figure 3. Furthermore, their exceptional charge carrier mobility enables efficient transportation of generated charges, minimizing energy losses. Another benefit arises from the tuneable bandgap of perovskite materials, allowing researchers to optimize their light-absorption properties to align with the solar spectrum, thereby further enhancing overall efficiency. In addition, perovskite solar cells can be produced using cost-effective techniques like solution processing or printing methods. This inherent advantage suggests the potential for lower manufacturing costs compared to conventional silicon-based solar cells mention in. Improvements in efficiency, manufacturing processes, and materials have made solar cells and panels more affordable and widely accessible.

As for improvement for emerging technologies itself perovskite continues the with the great development. In 2009, researchers in Japan (Kojima et al., 2009) achieved a power conversion efficiency (PCE) of 3.8% using a perovskite material called methylammonium lead iodide (CH3NH3PbI3). In 2012, researchers at the University of Oxford, led by Henry Snaith, significantly improved the efficiency of perovskite solar cells by replacing the organic hole-transporting material with a solid-state material. This breakthrough resulted in a PCE of 10%(Lee et al., 2012).

In 2018, the researcher from China achieved a PCE of 20% using low temperature, solution combustion based nickel oxide as hole transport layer (Liu et al., 2018). Perovskite solar cells attracted widespread attention and interest from the scientific community and industry due to their rapid efficiency improvements. In 2019 the efficiency increase to 23.32% (Jiang et al., 2019) which use surface passivation which the defects are significantly reduced and the recombination is suppressed. At the year of 2020 (Green et al., 2021) the efficiency reach 25% then increasing at 33.5% in the year 2023 (Green et al., 2024) which achieved by LONGi company for silicon-perovskite tandem. Figure 4 below shows the latest best research efficiencies chart for solar cells.

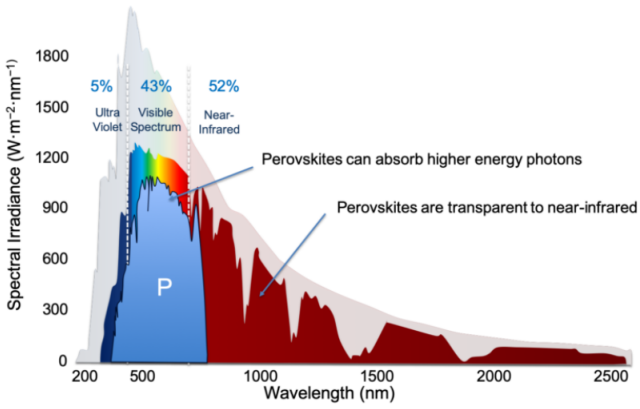

Figure 3: Absorbance of perovskite solar cell (Fisher, 2020)

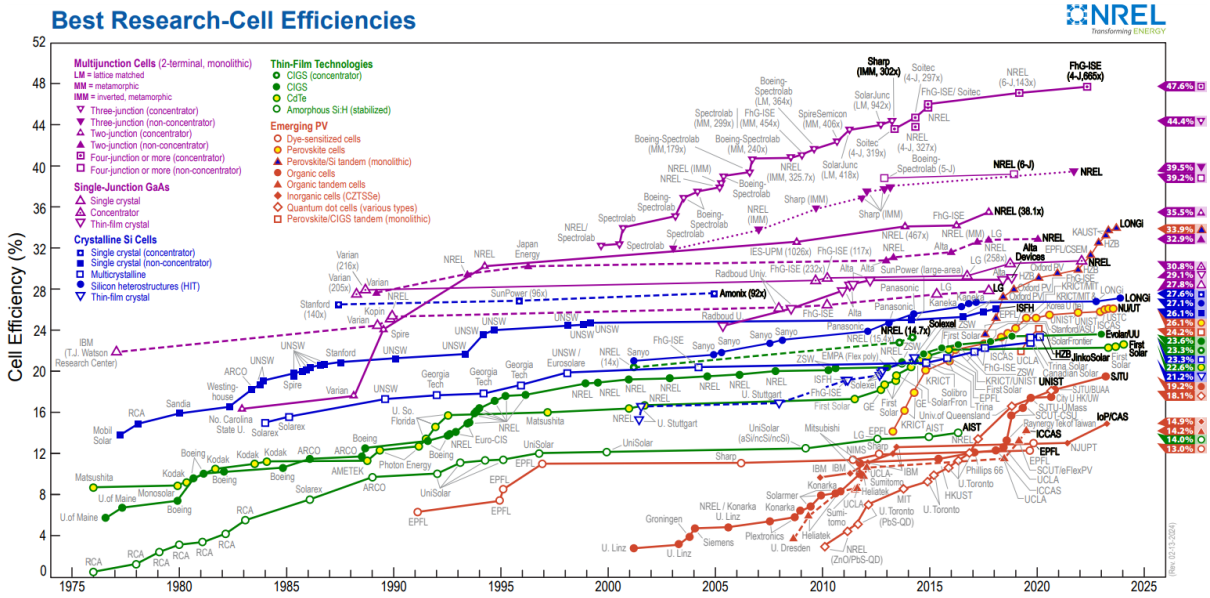

Figure 4: Best Research Cell Efficiencies Chart (NREL National Renewable Energy Laboratory, 2024)

CONCLUSION

Achieving the sustainable development goals (SDG) of having access to inexpensive and clean energy requires advances in manufacturing methods, materials, and efficiency. These changes are necessary to make solar cells and panels more broadly available and affordable. The SDG can be accomplished with the help of perovskite technology.

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