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IMPLEMENTATION OF POLYETHYLENE GLYCOL (PEG) AS PHASE CHANGE MATERIALS IN ZNR/P3HT/CUO: PEG INVERTED ORGANIC THIN FILM FOR SOLAR CELL APPLICATION

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ABSTRACT

Solar cell device is considered the most likely candidate as a renewable energy resource that does not emit carbon dioxide, unlike burning fossil fuels. The ability of solar cells to provide and being alternate device in providing the electricity made a striking demand over the years. However, there are few issues in solar cell that need to be considered and solved. One of the common issues in solar cell is its efficiency. The efficiency issue is crucial to be solved because the performance of solar cell is determined by their efficiency. Operating temperature is one of the factor that will affect the performance of solar cells. High operating temperature will drop the efficiency of the solar cells. Also, the configuration and structure of organic solar cell deposited with suitable method also plays an important role in determining the efficiency. The structure and arrangement of the p-n junction must be at optimized condition, to ensure the organic cells gave better performance. To improve the performance, phase change material (PCM) was corporated to the organic solar cell in this study, as the purpose to reduce the operating temperature. While to enhance the efficiency of organic solar cell in this study, the layers of zinc oxide nanorods (ZNR), poly (3-hexylthiophene) and copper oxide (CuO) composited with polyethylene glycol (PEG) were optimized accordingly to the varied parameters. All of these layers were deposited to produce ZNR/P3HT/CuO: PEG via sol-gel spin coating and chemical bath deposition method. Both of these methods are among the most versatile and simple fabrication technique. The solar cell measurement was conducted after the optimization process for each layer were completed. Solar cell device in this study was measured for only two parameters, which is the different concentration of CuO and the variation in PEG value in CuO solution. For the different concentration of CuO, 0.4M sample managed to produce highest V_{oc}, as compared to the other samples, which is 0.09 V. Meanwhile, the $J_{s}c$ value is 0.005, and FF is 0.021. From the measurement, the 9.46 x 10^{-5}% PCE was successfully obtain for 0.4M sample. This result might contribute from the roughness of the sample, which may affect by the thickness of the samples. As for the variation of PEG value in CuO solution, 2.5 mL PEG managed to produce highest PCE, which is 0.03%. This parameter was varied to prove that the presence of PEG as PCM was able to increase the performance of the solar cell. As been deducted, the addition of PEG in CuO could enhance the efficiency of the device. Beside PCE, this sample also exhibit highest V_{oc}, J_{sc} and FF, which are 0.195 V, 0.030 mA/cm^2, and 12.62 respectively. To prove that the presence of PCM could maintain the operating temperature of solar cell, the measurement was also conducted by applying external heat to the device. ZNR/P3HT/CuO with and without PEG were measured and compares. As the result, ZNR/P3HT/CuO: PEG exhibit higher efficiency, which is 0.02%, as compared with 0.01% for ZNR/P3HT/CuO. Throughout this study, it was found that the presence of PEG as the PCM in the solar cell configuration has the ability to improve the efficiency, V_{oc}, J_{sc} and FF. Thus, this study also contributes a finding that PCM could be implemented in solar cell and solar panel, as there are less or no other research had proved that PCM can be fabricated in these devices.

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