# Spectral Filtering of Photovoltaic Cells using Novel Bio-Filter: Silver Coated Hibiscus Extract using Water Solution

**Emetere Moses E., Adeyemo Nehemiah**

***Abstract*: The photovoltaic (PV) technology has evolved over the years based on the three main challenges i.e. efficiency, longevity and cost. Till date, there had not been a precise solution to the negative effect of solar IR radiation on the longevity of PV panels. In this research, the bio-filter was synthesized to filter harmful solar radiation. Bio-filter is made up of metallic coated plant extract. The monocrystalline and polycrystalline PV panel were used to test the performance of the bio-filter. It was observed that the bio-filter optimized the current generation in the panel to about 3%.***

***Keywords* : Photovoltaic, bio-filter, spectral filtering. Solar energy, energy***

## I. INTRODUCTION

The The recent challenges on the performance of photovoltaic (PV) in the tropics are worth noting [1-3]. It has been observed that PV panel works 50% below its capacity in the first year of purchase. It has been reported that the harsh weather in the tropics allow for harmful solar radiation to hit the surface of PV panel [4-5]. Hence, understanding solar electromagnetic spectrum over a geographical location is quite salient to install solar PV devices. The electromagnetic spectrum covers electromagnetic waves with frequencies between 1hertz to above 1025 hertz, corresponding to wavelengths from thousands of kilometres down to a fraction of the size of an atomic nucleus [6]. In electromagnetic spectrum the frequency range is divided into radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and at high-frequency (short wavelength) end of the spectrum is the gamma rays [7-8].

Scientists have observed that solar infra red radiations decrease the efficiency of the photovoltaic solar cells as it increases the temperature and then disturbs often the good operation of solar cells [9,10]. The challenges facing manufacturer is how to shield the PV panels from the solar IR radiations. Some researcher believes that the challenge of any PV panel depends on its materials [11-15]. For example, the solar IR does not affect silicon PV panel. In this research we proposed that the harmful solar radiation could be shielded from the PV cell using bio-filters. Bio-filters are metallic coated plant extracts. The plant extract used for this study is the hibiscus flower. Hibiscus is a genus of flowering plants that belongs to the Malvaceae family [16]. Hibiscus has several hundred species with varying legend as shown in Figure 1.

**Figure 1: Hibiscus flowering plant**

The bio-filter is expected to optimize and stabilize the performance of the PV panel. The polycrystalline and monocrystalline PV panels are used to test the efficiency of the synthesized bio-filter.

## II. MATERIALS AND METHOD

The materials used for the experiment includes: monocrystalline panel (3watt), solarimeter, silver nitrate (Ag2NO3), polycrystalline panel (4 watt), clean water, multimter, weighing balance, beaker and data logger.The biofilter was synthesized in the laboratory using hibiscus flower extract and silver nitrate. The hibiscus flower were gotten around the Ota environ, Nigeria. The flowers were divided into four parts. Each portion of the flower was grinded (using electronic blender) in 25ml of water (H2O). After blending, extracts were filtered out and mixed with 1.84g/mole of silver oxide (Ag2NO3) and then left for a day so that the silver compound can dissolve with the mixture. The filtrate was not heated to conserve the vital chemical components of the hibiscus flower (saturated hydrocarbons from 25 to 33 carbon atoms, esters, and carboxylic acids [16]). The two-polycrystalline PV panels (i.e. one panel sprayed with the biofilter and the second panel not sprayed) and four monocrystalline panels (i.e. two sprayed with the biofilter and the other two panels not sprayed) were connected to the data logger as shown in Figure 2.

The data logger was used to measure desired parameters such as radiation, current, voltage and power for two types of PV panels i.e. monocrystalline and polycrystalline. A data logger records and saves all readings gotten from the PV panels in an SD card.

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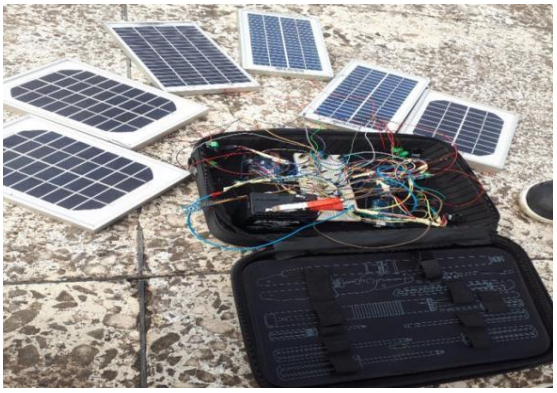

**Figure 2: Experimental set-up for field measurement**

## III. RESULTS AND DISCUSSION

The graph below (Figure 3) shows the UV radiation (w/m2) against time (sec) plot of the silver coated hibiscus extract in water solution for the polycrystalline panel. The maximum UV measured was 28W/m2. From the graph, it is noticed that were fluctuating radiations at different time i.e. owing to the irregular solar radiation in the tropics.

The graph below (Figure 4) shows the voltage (V) against time (sec) plot of the silver coated hibiscus extract in water solution for the polycrystalline panel. The blue legend shows the coated panel while the green legend shows the uncoated polycrystalline panel. It was observed from the graph that at the first 0 – 2500sec, the voltages for both panels were not stable. The voltage of the uncoated panel gave higher output than the coated panel.

The graph below (Figure 5) shows the current (A) against time (sec) plot of the silver coated hibiscus extract in water solution for the polycrystalline panel. It is observed that the current of the coated panel (blue legend) was higher than of the uncoated (green legend) panel even though the voltage of the uncoated panel was higher. The graph for the coated cell is sinusoidal, while for the uncoated cell is transient.

The graph below (Figure 6) shows the power (W) against time (sec) plot of the silver coated hibiscus extract in water solution for the polycrystalline panel. The blue legend shows the coated panel while the green legend shows the uncoated polycrystalline panel. This shows some of the features seen in the graph above, where there is a steady increase in the power of the coated panel and perturbations for the uncoated panel.

The graph below (Figure 7) shows the UV radiation ($w/m^2$) against time (sec) plot of the silver coated hibiscus extract in water solution for the monocrystalline panel. The UV over the period was at its peak at $28W/m^2$. From the graph it is noticed that were fluctuating radiations at different time.

The graph below (Figure 8) shows the voltage (V) against time (sec) plot of the silver coated hibiscus extract in water solution for the monocrystalline panel. The blue legend shows the coated panel while the green legend shows the uncoated monocrystalline panel. It is observed from that graph that there were a lot of perturbation in relation to the coated panel which show very sharp rise and fall of voltages, and for the uncoated panel, the voltage in relation to time was relatively stable even though there was also a rise and fall of voltages. From this it can be said that the extract did not improve the output of the monocrystalline panel.

The graph below (Figure 9) shows the current (A) against time (sec) plot of the silver coated hibiscus extract in water solution for the monocrystalline panel. The blue legend shows the coated panel while the green legend shows the uncoated monocrystalline panel. It is observed that the current of the uncoated panel is higher than the coated panel, it is noticed from the graph that the coated panel actually had a higher from 0 – 200sec, then the current of both panel became relatively the same until 700-5400sec where the current of the uncoated panel was slightly more.

The graph below (Figure 10) shows the power (W) against time (sec) plot of the silver coated hibiscus extract in water solution for the monocrystalline panel. The blue legend shows the coated panel while the green legend shows the uncoated monocrystalline panel. It is observed that the power graph and the voltage graph are very much similar in the sense that for the coated panel perturbations or fluctuations were observed.

## IV. CONCLUSION

The bio-filter performance was adjudged to show little success i.e. with about 3% increase of output parameters. The pattern of the output did not change because the bio-filter is not an internal PV system, hence the possibility that its output trend may be same as the uncoated PV panel. The plant extract is not very perfect, hence there is the need to screen more plants extract to synthesize a perfect bio-filter. Further research is required for the determination of an appropriate bio-filter.

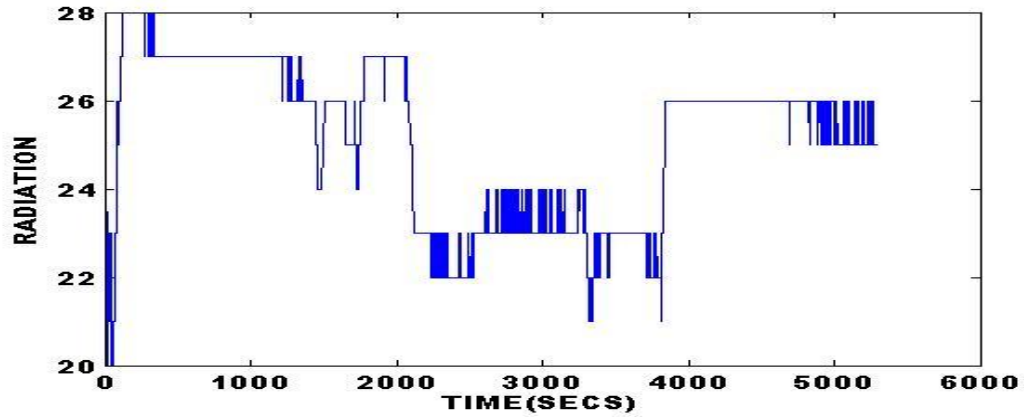


**Figure 3: UV radiation (w/m$^2$) against time (sec) of coated polycrystalline panel.**

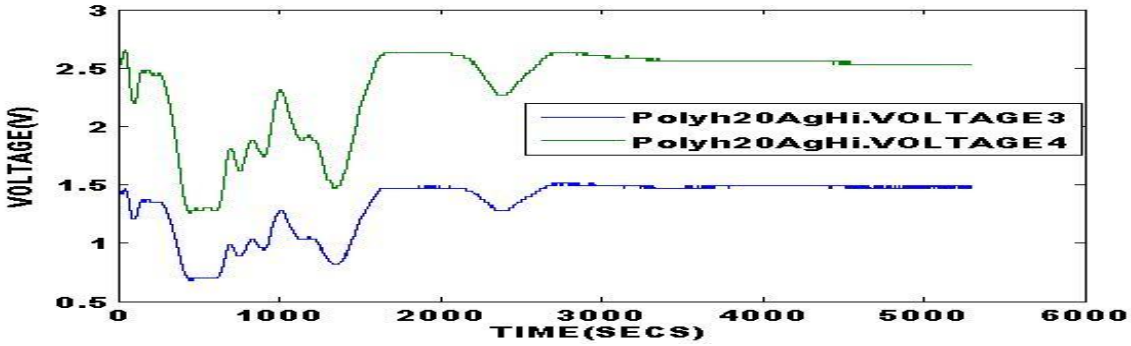


**Figure 4: Voltage (V) against time (sec) of coated polycrystalline panel.**

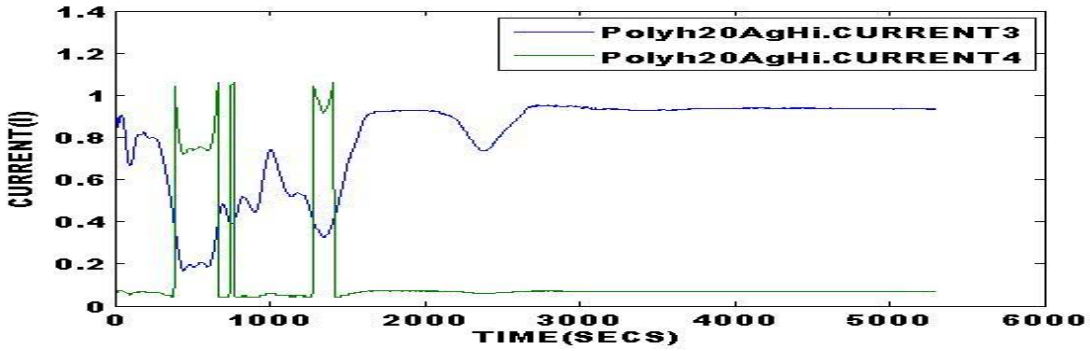


**Figure 5: Current (A) against Time (Sec) of coated polycrystalline panel.**

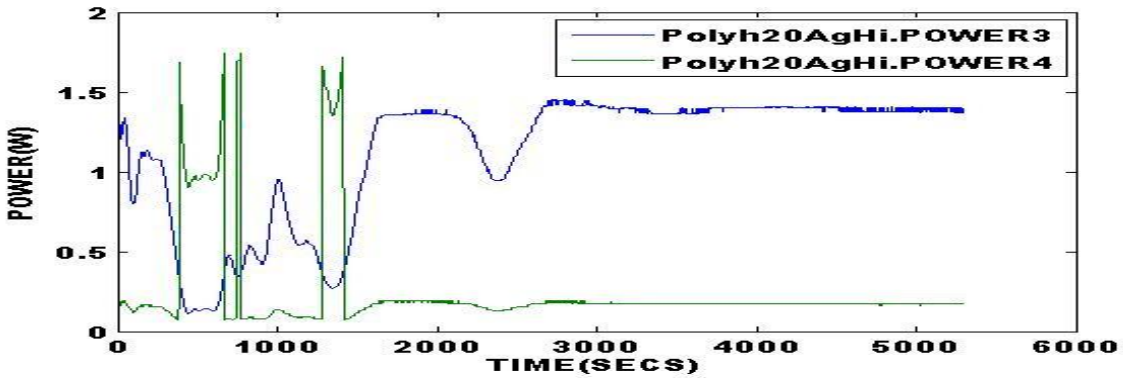


**Figure 6: Power (W) against time (sec) of the silver coated hibiscus extract in water solution for the polycrystalline cell.**

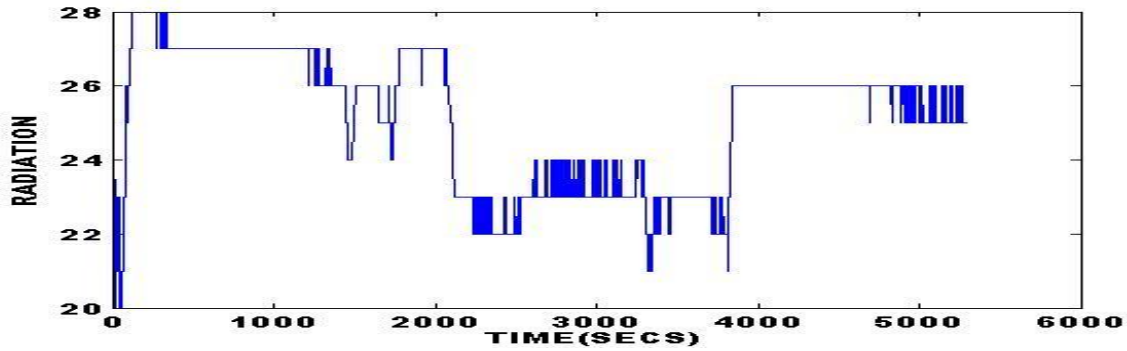


**Figure7: UV radiation (w/m$^2$) against time (sec) of silver coated hibiscus extract in water solution for the monocrystalline panel.**

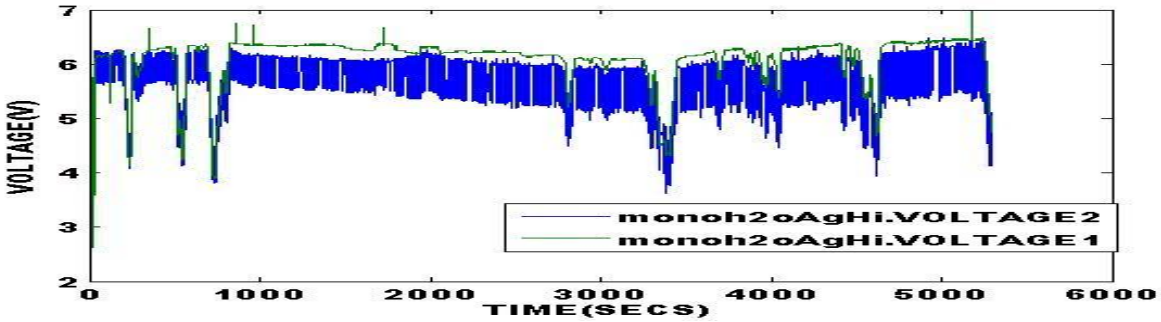


**Figure 8: Voltage (V) against time (sec) of the silver coated hibiscus extract in water solution for the monocrystalline panel.**

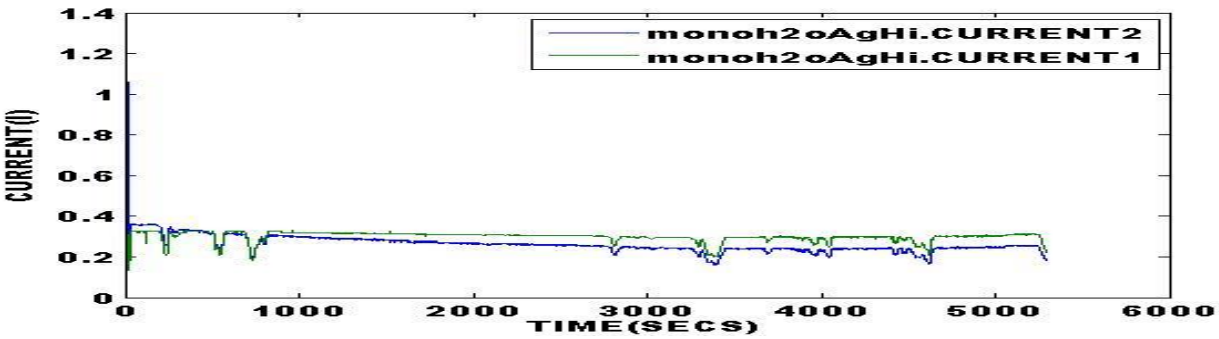


**Figure 9: Current (A) against time (sec) of the silver coated hibiscus extract in water solution for the monocrystalline panel.**

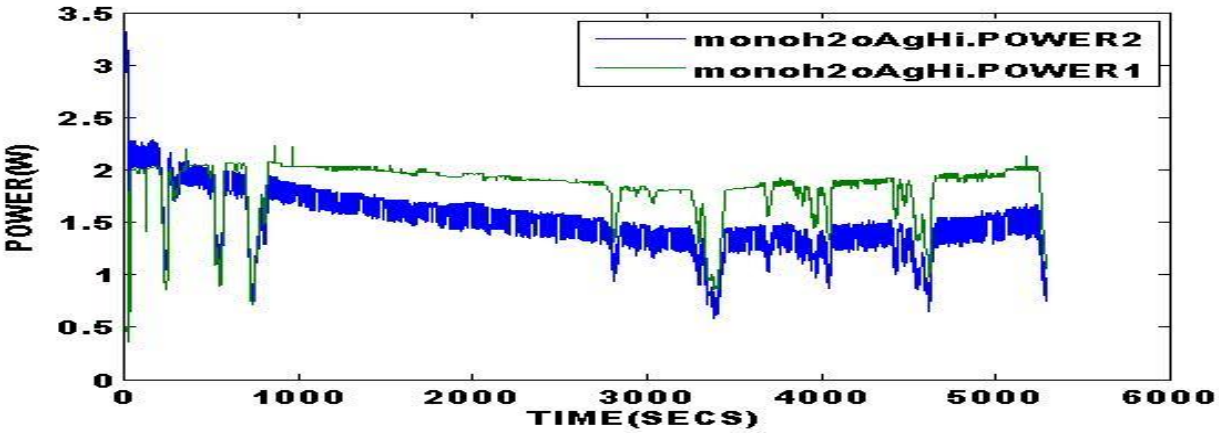


**Figure 10: Power (W) against time (sec) of the silver coated hibiscus extract in water solution for the monocrystalline panel.**

## ACKNOWLEDGMENT

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