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Improve the Performance of Porous Silicon for Solar Application by Imbedding of Aloe Vera Nanoparticle

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Abstract:

This work is concerned with the fabrication of nanocrystalline porous silicon (PSi) by electrochemical etching method . Aloe Vera (NPs) have been prepared by simple chemical method. And study of the effect of (Aloe Vera) on the (p-PSi and n-Psi) by using the drop casting technique procedure at a temperature of 50 ºC. Optical properties of Aloe Vera nanoparticles was UV–Vis spectrophotometer, FTIR. results of the current–voltage (I-V) test manifested that the maximum power conversion efficiency (PCE) of the solar cell and the filling factor for p-PSi, n-PSi were 0.67%,20.80% and 2.029%, 29.74% respectively. The diffusion of Aloe vera NPs on the PSi hetrojunction assures that there was an improvement upon their properties.

Keywords: *PSi; Aloe vera; optical properties; etching; FTIR,*

I. Introduction

PSi is the important materials with a wide range of applications. [1,2,3]. Although optoelectronics, especially light emission, has been the primary area of interest in porous silicon for the past 27 years, the substance has recently found its way into the cosmetics, consumers, nutrition and food industries. The preparation of porous silicone is simple and inexpensive. It can be performed by several methods depending on the desired structure and properties. Show highly adjustable structural, mechanical, optical, electrical, thermal, emissive and physical chemical properties. Some of its properties, such as luminescence and medical biological degradation, are direct results of the porosity of nanoparticles [4]. In this way, the current investigation focused on (1) investigating the visual synthesis and imaging of vera plant molecules using a direct techniqueAt the beginning periods of software process it is hard to characterize a total software specification. Hence, in spite of the fact that product may adjust to its specification, clients don't live up to their quality desires.

2. Fabricated of porous silicon

An electrical device was used to manufacture porous silicon using a substrate silicon wafer with an electrolytic Teflon cell containing 43% hydrofluoric acid and pure ethanol, as shown in Figure 1. The sample made of monocrystalline silicon was treated with a resistance of 10 m and a direction (100). The chemical drilling process was to create a protector using a 10 mA / cm 2 current

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for 10 minutes and then, a thin layer of a thin layer of aluminum was deposited on the back surface using heat evaporation technique.

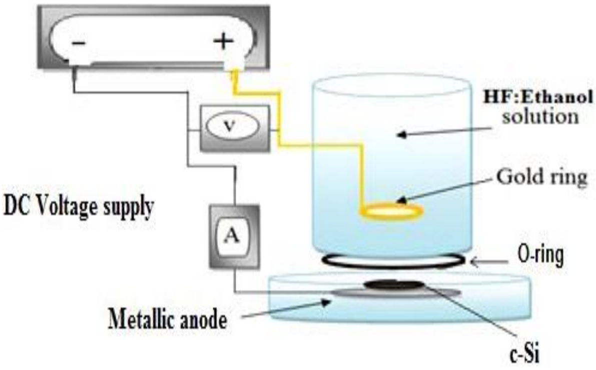

Fig. (1): Schematic diagram of the electrochemical etching set-up.

3. Prepared of Aloe vera nanoparticles by chemical reaction

(AV) plant extricate was utilized as crude materials. The (AV) separate arrangement was readied utilizing 10 grams of aloe vera leaves that were flushed with deionized water, after a year has passed since the solution see Fig. 1.

Fig. (2): Photo image of Aloe Vera.

Aloe vera deposite on a glass using drop casting method on the glass substrate ,see Figure (3). The precursor solution of (Aloe Vera) was deposited by the same method on preheated transparent conductive porous silicon at 40ºC, time sintering time is 10 min.

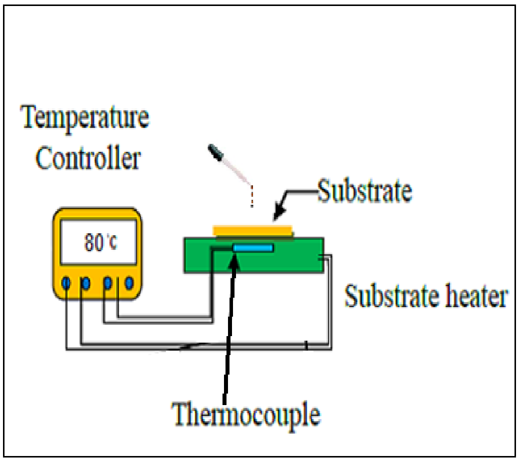

Fig. (3): diagram drop casting method.

3- Result and discussions

Optical assimilation spectra of the movies in ghostly scope of (300-1100) nanometer were recorded by utilizing UV–range spectro-photometer. The examination the reliance of retention coefficient on photon vitality in the high assimilation areas is performed to get the point by point data about the vitality band holes of the movies. The (Ko) is calculated using the relation (1) [5]. Figure (4) show the Ko as a function of wavelength, the (Ko) decreases slowly at short wavelengths (300-410) nm and after that the values of (Ko) increase rapidly. The rise and fall in the value of (Ko) is directly related to the absorption of light. The extinction coefficient of prepared film has value in the range of (0.038).

$$Ko = \alpha \lambda / 4\pi \qquad (1)$$

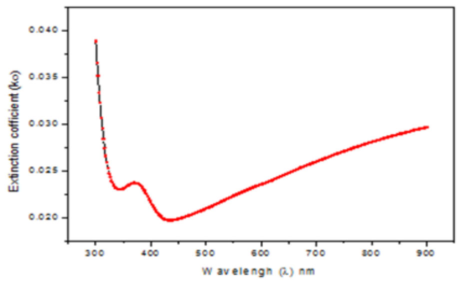

Fig. (4): K_0 versus (λ) for Aloe Vera thin film.

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Figures (5,6) show (ε1 and ε2) are determined by using equations (2) and (3) respectively [6]. The plots of real and imaginary part of sample are illustrated in figures (5) and (6) espectively. Figures (5,6) show that ε1 & ε2 for sample behave inverse the extinction coefficient as a function of λ.

ε1 = (n2 - Ko2) (2)

ε2 = (2n Ko) (3.

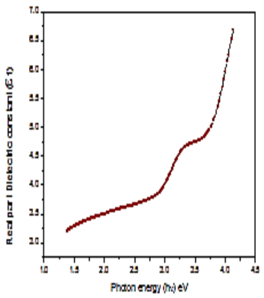


Fig. (5): ε_1 versus (hν) for Aloe Vera thin film.

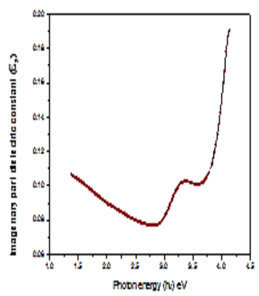


Fig.(6): ε_2 versus (hν) for Aloe Vera thin film.

The optical conductivity is calculated, from equation (4) [7]. Figure (7) appearsthat the conductivity increases in the VIS range as the incident energy of photonincreases. The increase is rapid at hν>Eg. It can be noticed also that the optical conductivity varies in a similar way as the change of the imaginary part of constant dielectric of , because it depends on it.

δ* = ε2ω εo (4)

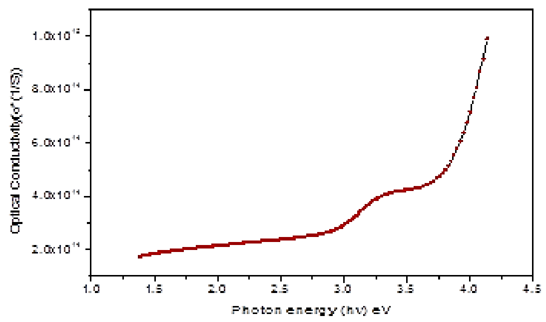


Fig. (7): The optical conductivity as a function of energy of photon for Aloe Vera thin film.

Figure 8 appears the FTIR spectrum of the aloe vera sample that appears large absorption peaks for humans in an absorption area with a width of (500-4000) 1/cm cm intended for dilatation of aloe vera spectra. The infrared spectrum of the aloe vera gel extract as shown in Figure 8 was in the wavelength range from 551.6 /cm to 3392.55 1/cm and the presence of aloe vera was aromatic, phenol, substituted alkene, aromatic halida acid, on the Vatican halide acid, ether (ROR), Second alcohol (R-OR), nitro (NO2),

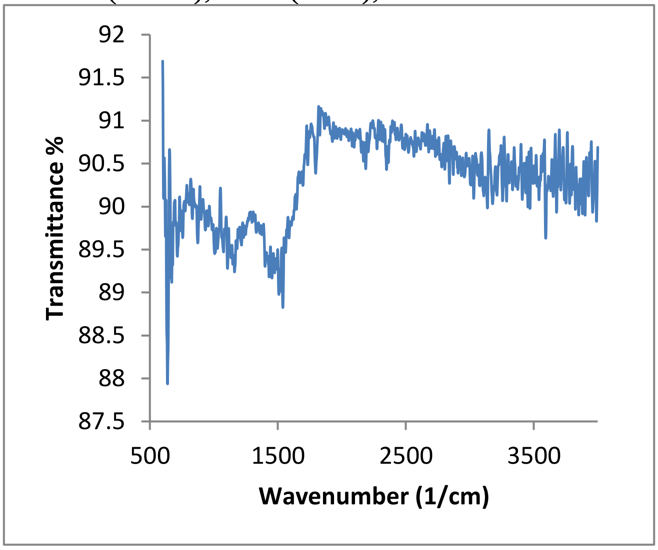


Fig. (8): FTIR spectra of Aloe Vera thin film.

Figure (9) appears that the Aloe Vera particles are deposited on the surface silicon only four drops by the drop casting method then dry at 80 oC, to fabricate the solar cell Aloe Vera /Si. I-V dark characteristics in forward and reverse direction of AV /porous silicon Si/Al for solar cells applications . Forward current of solar cell is a small at voltages less than three volts. This current is called recombination current which occurs, at a min. voltages only. It is generated, when each electron, excited form valence band to the conductive band. The next region, at max. voltage, called the diffusion, which depending on resistance**.**

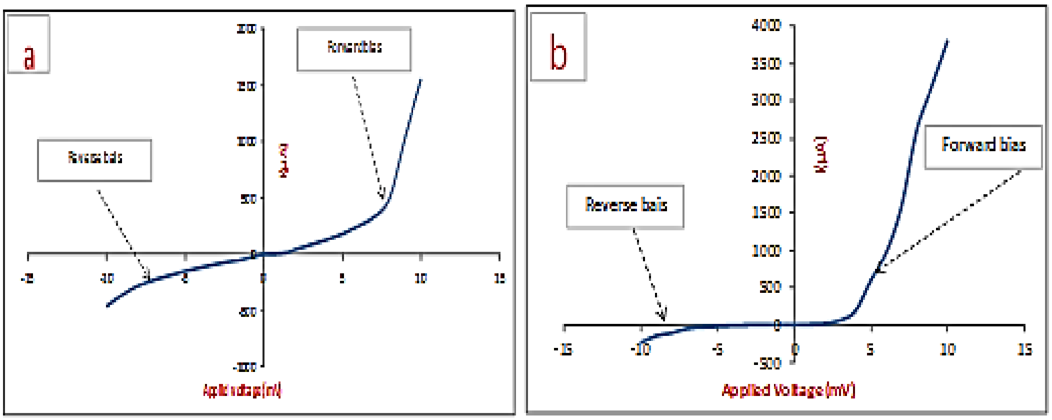
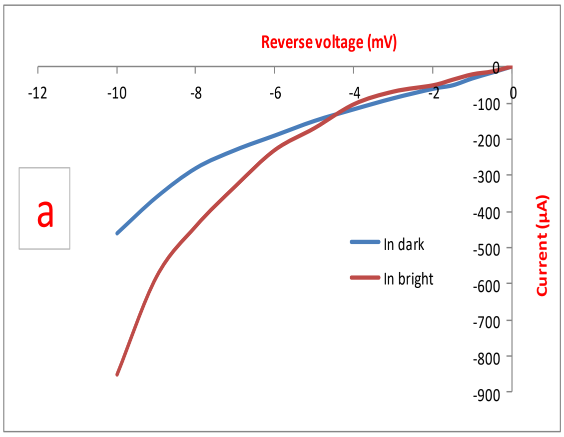


Fig. (8):I-V characteristic under forward reverse bias of the (**a**) AV/n-PSi hetrojunction, (**b**) AV/p-PSi heterojunction.

Figure (9) appears that the reversed current-voltage, characteristics of the device measured, in dark and the photocurrent under a 10 mW/m2, illumination. It can be seen that the reverse current value at a given voltage for AV/n, p-Si hetetrojunction under illumination is higher than that in the dark this indicate that the light generated carrier –contributing photocurrent due to the production of electron –hole as a result of the light absorption. This behavior yield, useful information on, the electron-hole pairs, which are effectively, generated in the, junction by incident photons.



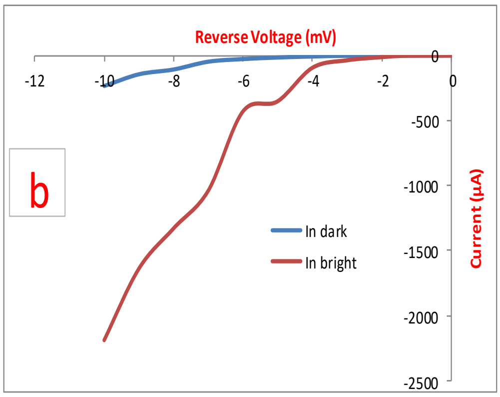


Fig. 9: Illuminated (I-V) characteristic of for (a) AV/n-PSi solar cell, (b) AV/p-PSi solar cell.

Figure (10) study the I-V properties for AV/porous silicon heterojunction. Isc, Voc , F.F.% and **η** for p and n porous silicon are 1.1 μA, 23 mV, 20.80% and 0.67% ; 1.7 μA, 31.5 mV, 29.74% and 2.029% respectively. Were calculated using Eqs.(5) and (6)[8-10]

$$FF(\%) = \frac{J_{max}V_{max}}{J_{sc}V_{oc}} = \frac{P_{max}}{J_{sc}V_{oc}} \times 100\% \qquad (5)$$

$$\eta(\%) = \frac{J_{max}V_{max}}{P_{in}} = \frac{P_{max}}{P_{in}} = \frac{J_{sc}V_{oc}}{P_{in}} FF \times 100\% \qquad (6)$$

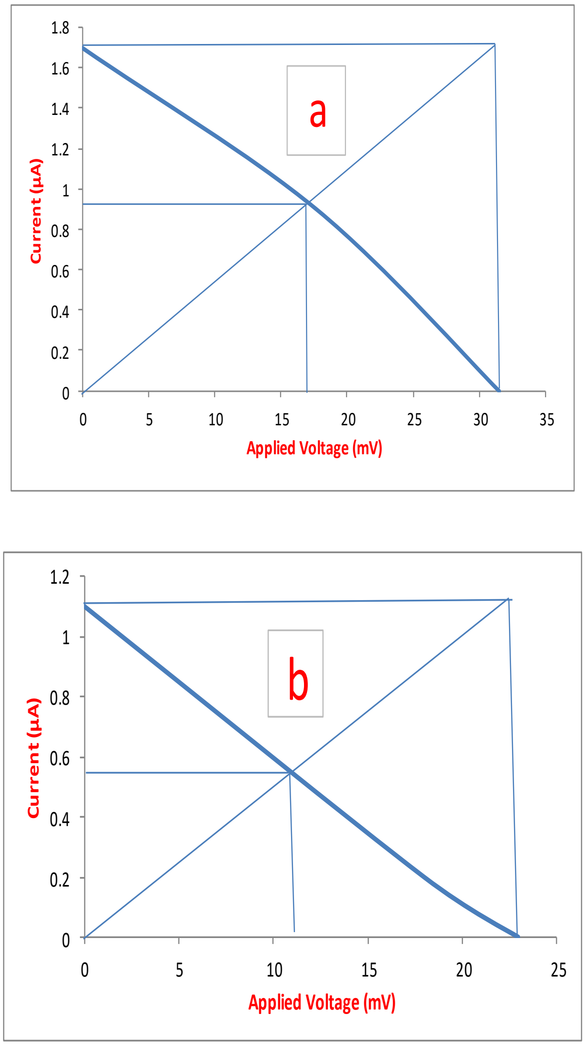


Fig.10: I-V characteristics for solar cell with illumination for **(a)** AV/n-PSi, **(b)** AV/p-PSi.

Conclusions

Solar cell was successfully fabricated, also, the results showed that the descriptions of the prepared AV NPs are the nanostructures, which were used as electrodes for the solar cell. It was observed that the electrical properties of the solar cell were enhanced by AV NP compounds and porous silicon.

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