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A Study of Green Synthesized Silver Nanoparticles (AgNPs) for Production in both AC and DC Current

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ABSTRACT

The bio-voltaic cells and battery have been designed and developed for both DC (Direct current) and AC (Alternating current) power generation. A study for DC load voltage, AC load voltage, internal resistance, maximum power, open circuit voltage and short circuit current have been measured for practical utilizations. An inverter has been used to convert DC electricity in to AC electricity. The variation of DC load voltage and the variation of AC load voltage with time have been studied. It is seen that for without AgNPs the change of AC load voltage is greater than the change of DC load voltage. It is also seen that for without AgNPs the change of AC load voltage is greater than the change of DC load voltage. But the it is also seen that for with and without AgNPs the change of both DC and AC load voltages are greater than the change of both DC and AC load voltages respectively. It is also found that the internal was reasonable for 160 hrs time duration. The maximum internal resistance was 3.43 ohm and the minimum internal resistance was 3.31 ohm without use of AgNPs. The difference was 0.12 ohm. It has been synthesized AgNPs using PKL extract. The effect of AgNPs have studied for use in both DC and AC appliances. It is shown that the performances of AgNPs are better for both DC and AC appliances.

Keyword: AgNPs, AC load voltage, DC load voltage, Green synthesis, Direct current, Bio-volaic cell.

I. Introduction

Electricity is important for all sectors in the society[1-4]. To keep it in mind we have studied and developed electricity generation method using PKL extract and CuSO4 together[5-10]. That means,

PKL extract + CuSO4 = Electrolyte(Fuel) .... (1)

The extract of PKL and CuSO4 make a solution that acts as an electrolyte and Cu plate acts as a positive electrode and the Zn plate acts as a negative electrode[11-14]. That means,

Cu(solid) + Zn(solid) = Electrode ....(2)

A positive electrode and a negative electrode with PKL extract and CuSO4 makes an PKL electrochemical cell[15-21]. That means,

PKL extract + CuSO4 + Cu(solid) + Zn(solid) = Electricity .... (3)

More than electrochemical cells make a PKL battery[22-24]. The series or parallel connected PKL battery make a PKL module. Again, more than PKL module makes a PKL panel[25-27]. The series or parallel connected PKL panels make a different kinds of PKL power plant[28-29]. As per our required we can design and fabricate PKL power plant like micro, mini, mid-level and large level PKL power plant[30].

Finally, for getting more performance we have used liquid AgNPs by the following equation:
PKL extract + CuSO4 + Cu(solid) + Zn(solid) + AgNPs = More Electricity .....(4).

II. Methods and Materials

II. A Materials:

DC LED bulb, DC energy bulb, AC bulb, Inverter, Multimeter, Connecting wire, Copper plate, Zinc Plate, Battery box, AgNPs

II. B. Silver Nanoparticles (AgNPs) synthesis for practical utilizations

Fig. 1 Initial stage of AgNPs

Fig. 2 2nd stage of AgNPs

Fig. 3 3rd stage of AgNPs

Fig.1 shows the initial stage of synthesized AgNPs. Fig.2 shows the 2nd stage of synthesized AgNPs after 10 minutes. Fig.3 shows the 3rd stage of synthesized AgNPs after 30 minutes. The synthesized AgNPs are in liquid form. It has been used in the PKL electro chemical cells for both in DC and AC electricity.

II. C Methods:

The methods for determination of different parameters are given below:

Fig. 4 indicates the AC load voltage, Fig. 5 indicates the DC load current without NPs, Fig. 6 indicates the AC load voltage without NPs, Fig. 7 indicates the AC load current without NPs , Fig. 8 indicates the DC load voltage with NPs , Fig. 9 indicates the DC load current with NPs, Fig. 10 indicates the AC load voltage with NPs, Fig. 11 indicates the AC load current without NPs, Fig.12 indicates the internal resistance measurement and Fig. 13 indicates the Maximum Power measurement with the variation of time duration.

Fig. 4 DC load voltage without NPs

Fig. 5 DC load current without NPs

Fig. 6 AC load voltage without NPs

Fig. 7 AC load current without NPs

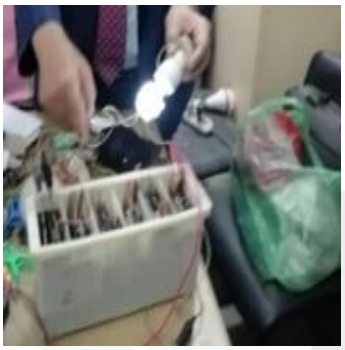

Fig. 8 DC load voltage with NPs

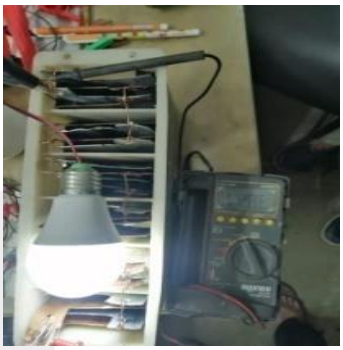

Fig. 9 DC load current with NPs

Fig. 10 AC load voltage with NPs

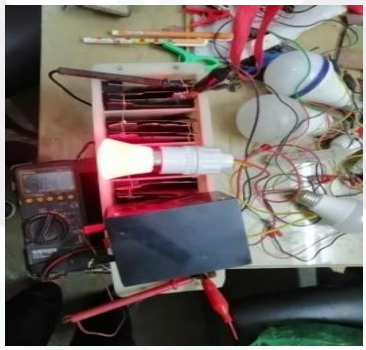

Fig. 11 AC load current without NPs

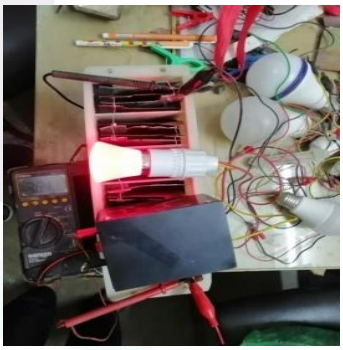

Fig. 12 Internal resistance measurement

Fig. 13 Maximum Power measurement

III. Results and Discussion

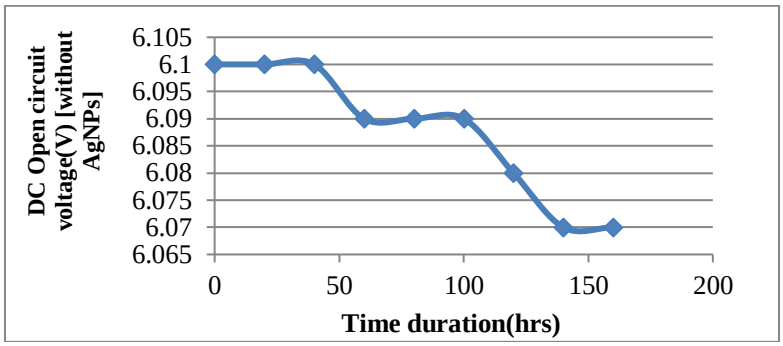

Fig. 14 Variation of open circuit voltage (V) [without AgNPs] with the variation of time durations

Fig.14 indicates the variation of DC open circuit voltage [without AgNPs] with the variation of time durations. The DC open circuit voltage [without AgNPs] varies from 6.10 volt to 6.07 volt for 160 hrs. For 1st 50 hrs, it was almost constant then for 10 hrs it decreases directly and then after it was almost constant up to 100 hrs. Then from 100 hrs to 140 hrs it decreases directly and finally it was almost constant up to 160 hrs.

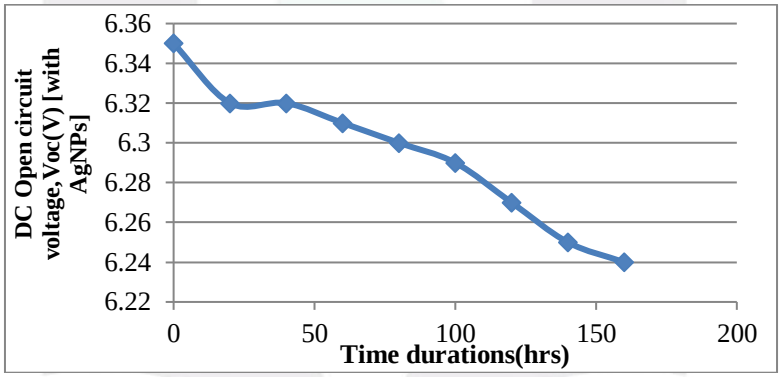

Fig. 15 Variation of DC open circuit voltage(V) [with AgNPs] with the variation of time durations

Fig. 15 shows the variation of DC open circuit voltage(V) [with AgNPs] with the variation of time durations. The DC open circuit voltage(V) [with AgNPs] varies from 6.35 V to 6.24 V. The difference between the maximum and minimum voltage is 0.11 V. The voltage decreases directly up to 30 hrs. Then it was almost constant up to 40 hrs. Then after it decreases almost linearly up to 160 hrs.

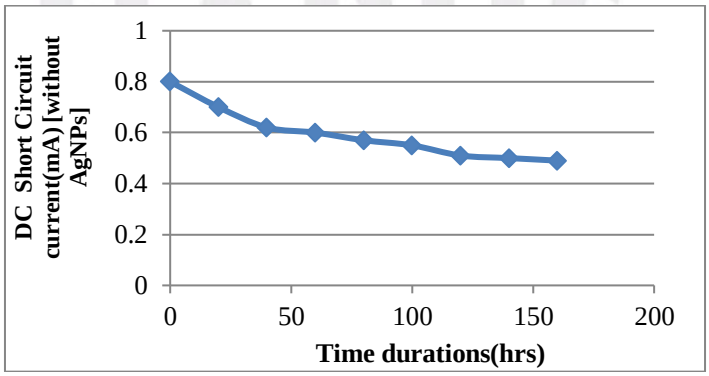

Fig. 16 Variation of DC short circuit current (mA) [without AgNPs] with the variation of time durations

Fig. 16 shows the variation of DC short circuit current (mA) [without AgNPs] with the variation of time durations. The maximum value of DC short circuit current (mA) [without AgNPs] is 0.8 mA and minimum value is 0.5 mA. The current decreases almost exponentially up to 160 hrs.

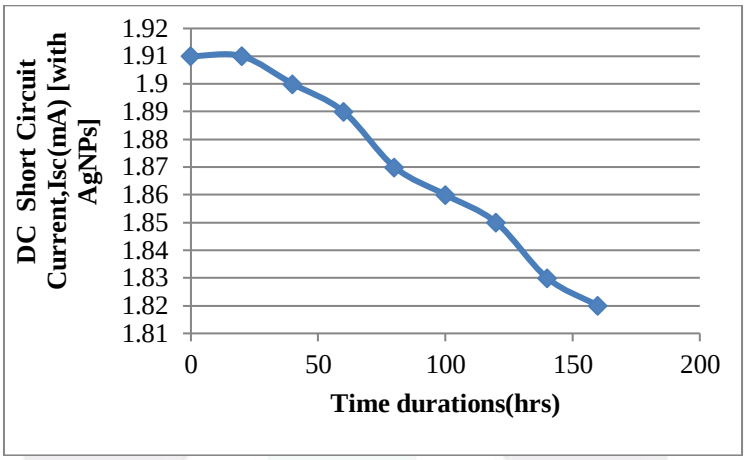

Fig. 17 Variation of DC short circuit current (mA) [with AgNPs] with the variation of time durations

Fig. 17 shows the variation of DC short circuit current (mA) [witht AgNPs] with the variation of time durations. The maximum value of DC short circuit current (mA) [without AgNPs] is 1.91 mA and minimum value is 1.82 mA. The current was constant for 10 hrs and the the current decreases almost linearly up to 160 hrs.

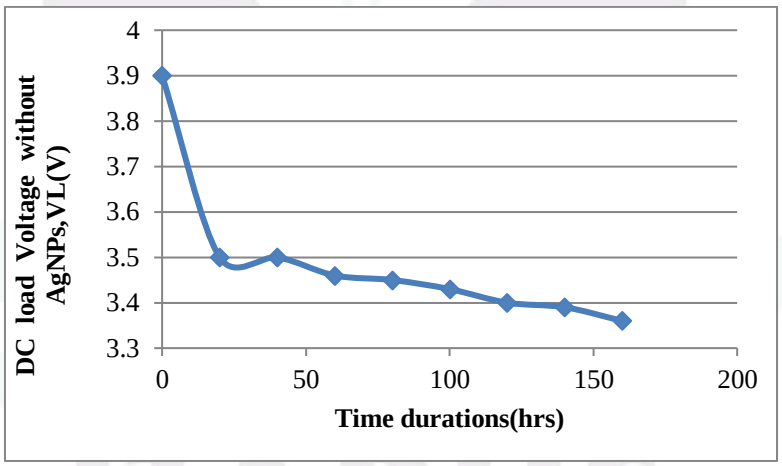

Fig. 18 Variation of DC load voltage (V) [without AgNPs] with the variation of time durations

Fig. 18 shows the variation of DC load voltage (V) [without AgNPs] with the variation of time durations. The maximum value of DC load voltage (V) [without AgNPs] is 3.9 V and minimum value is 3.5V. The voltage falls rapidly up to 10 hrs and then after decreases slowly up to 160 hrs.

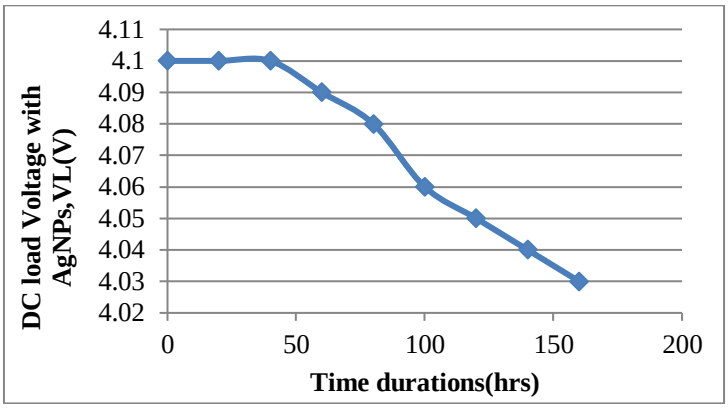

Fig. 19 Variation of DC load voltage (V) [with AgNPs] with the variation of time durations

Fig. 19 shows the variation of DC load voltage (V) [with AgNPs] with the variation of time durations. The maximum value of DC load voltage (V) [with AgNPs] is 4.10V and minimum value is 4.03V. The voltage falls rapidly up to 10 hrs and then after decreases linearly up to 160 hrs.

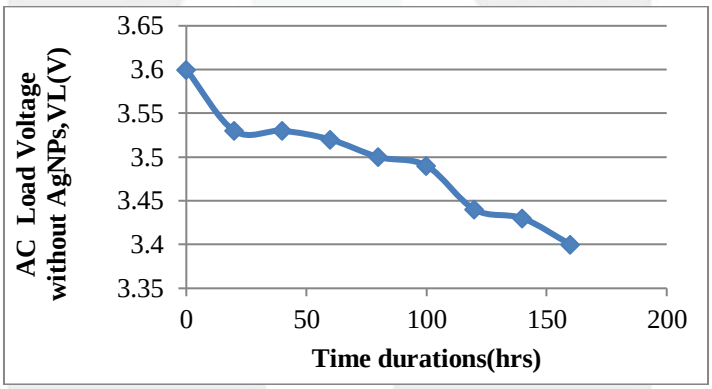

Fig. 20 Variation of AC load voltage (V) [without AgNPs] with the variation of time durations

Fig. 20 shows the variation of AC load voltage (V) [without AgNPs] with the variation of time durations. The maximum value of AC load voltage (V) [without AgNPs] is 3.6 V and minimum value is 3.4 V. The voltage falls rapidly up to 10 hrs and then after decreases almost linearly up to 160 hrs.

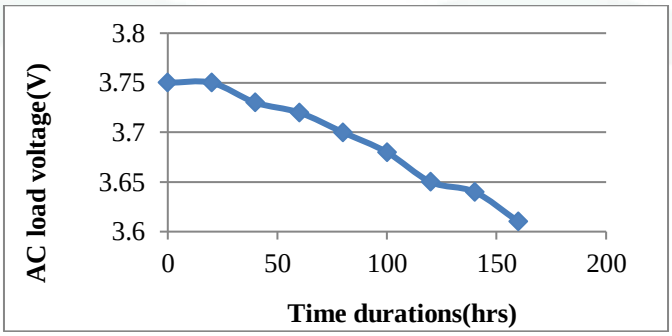

Fig. 21 Variation of AC load voltage (V) [with AgNPs] with the variation of time durations

Fig. 21 shows the variation of AC load voltage (V) [with AgNPs] with the variation of time durations. The maximum value of AC load voltage (V) [with AgNPs] is 3.75 V and minimum value is 3.6 V. The voltage falls rapidly up to 10 hrs and then after decreases almost linearly up to 160 hrs.

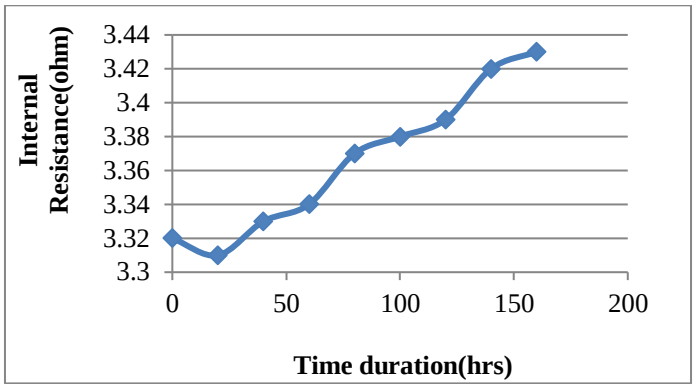

Fig. 22 Variation of internal resistance (ohm) [without AgNPs] with the variation of time durations

Fig. 22 shows the variation of internal resistance (ohm) [without AgNPs] with the variation of time durations. The maximum value of internal resistance (ohm) [without AgNPs] is 3.43 ohm and the minimum value is 3.32 ohm. The internal resistance increases almost constant up to 10 hrs and then after increases almost linearly up to 160 hrs.

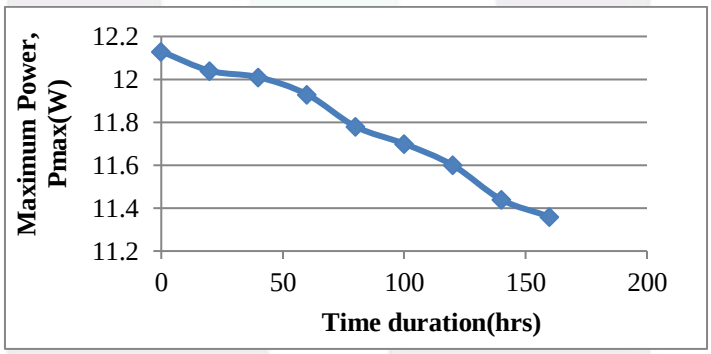

Fig. 23 Variation of Maximum Power (W) [without AgNPs] with the variation of time durations

Fig. 23 shows the variation of Maximum Power (W) [without AgNPs] with the variation of time durations. The maximum value of Maximum Power (W) [without AgNPs] is12.1 W and the minimum value is 11.38 W. The maximum power (W) falls linearly up to 10 hrs and then after increases almost linearly up to 160 hrs.

IV. Conclusions

It is an innovative work. The mixture of PKL extract, CuSO4 and AgNPs may be the alternative fuel for electricity generation method. It has been only PKL extract as an electrolyte. The performance is not good than the mixture of PKL extract, CuSO4 and AgNPs as an electrolyte. Similarly only the use of CuSO4 and the AgNPs as an electrolyte separately. There are many articles have been published on PKL electricity for DC current. But this article has been studied for both DC and AC current generation for practical applications.

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