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Ozone and NaCl based electrolytic solar cell

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Abstract: *The mechanism of ozone and NaCl based electrolytic solar cell is presented in a different way. The mechanism is similar to galvanic effect. The galvanic effect is based on two types of cations in which one metal is oxidized and the other metal is reduced. In the present paper instead of NaCl ionic solution it is also shown that one can also try using NaOH, KCl, KOH, $MgCl_2$, $Mg(OH)_2$, $ZnCl_2$, $Zn(OH)_2$, $CuCl_2$, $Cu(OH)_2$, $CaCl_2$, $Ca(OH)_2$ ionic solutions. This needs trial and error experimentation. This present solar cell is novel solar cell and is cost effective and also produces higher output and requires one third of area to establish the solar power plants if successful in developing the electrolytic solar cell.*

Keywords: *Ozone; NaCl; Electrolytic solar cell; photovoltaic; galvanic.*

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I. Introduction

Over the last many decades the research on solar cells is carried out on the different type of inorganic materials using Si, GaAs, CdTe, CIS, CIGS, GaN and CZTS with power conversion efficiency for these solar cells varying from 8 to 40% [1-10]. Over the last few decades research has been focused on the solar cells based on dye sensitized, inorganic and polymer materials [11-16] which have conversion efficiencies 6 to 25% because they have lower cost when compared to inorganic material based solar cells. Keeping in mind the lower cost and higher power conversion efficiency, in our earlier report we have presented idea on ozone and NaCl based electrolytic solar cell [17]. We have shown that this ozone and NaCl based electrolytic solar cell is cost effective and produces higher power output. In the case of ozone and NaCl based electrolytic solar cell, the total initial investment required to produce the power output of $12x10^{13}$W.h in one month to meet the entire power need of India would be $5.32x10^{11}$ INDIAN rupees. This is five orders of magnitude (10^5 times) less than the requirement for the solar cells based on inorganic and dye sensitized materials ($4.2x10^{16}$ INDIAN rupees). The area required to setup the ozone and NaCl based electrolytic solar cell is one third to that required on above inorganic and dye sensitized solar cells. In the present paper the author tried to explain the mechanism of ozone and NaCl based electrolytic solar cell in different possible ways which need focus and trial. Instead of NaCl one can also use NaOH, KCl, KOH, $MgCl_2$, $Mg(OH)_2$, $ZnCl_2$, $Zn(OH)_2$, $CuCl_2$, $Cu(OH)_2$, $CaCl_2$, $Ca(OH)_2$ solutions. This needs trial experimentation.

II. Results and discussion

The mechanism of ozone and NaCl based electrolytic solar cell is shown in a different way. In the ozone and NaCl based electrolytic solar cell we use two electrolytes. One electrolyte is ozone (O_3) gas and the second electrolyte is sodium chloride (NaCl). These two electrolytes are kept in two different chambers. The working principle of Ozone and NaCl based electrolytic solar cell is as follows which is similar to galvanic effect using two different cations. The sunlight dissociates ozone gas in to oxygen molecule and nascent oxygen ions releasing 2 electrons at anode. This process is called oxidation process. The released electrons due to oxidation of ozone in to oxygen molecule and nascent oxygen are captured by sodium ions and reduced in to sodium metal at the cathode. In the present electrolytic solar cell, the process is similar to galvanic effect. The oxidation of oxygen ion at the anode and reduction of sodium ion at the cathode results in flow of two electrons in the external circuit from anode to cathode. The equation for the galvanic process using ozone molecule, oxygen molecule, nascent oxygen ion and sodium ion are shown below. The chlorine ion also oxidizes in to chlorine molecule with the release of two electrons. The released electrons are capture by sodium ion and get reduced in to sodium metal. This also produces additional electrical current in the external circuit.

Trial using NaCl
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2Cl^{-1} \rightarrow Cl_2 + 2e^{-1}$ (at Anode/Cathode)
$4Na^{+1} + 4e^{-1} \rightarrow 4Na$ (at Cathode)
Instead of NaCl one can also use NaOH, KCl, KOH, $MgCl_2$, $Mg(OH)_2$, $ZnCl_2$, $ZN(OH)_2$, $CuCl_2$, $Cu(OH)_2$, $CaCl_2$, $Ca(OH)_2$ solutions, it needs a trial.

Trial using NaOH
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2(OH)^{-1} \rightarrow H_2O + O^{-2} + 2e^{-1}$ (at Anode/Cathode)
$4Na^{+1} + 4e^{-1} \rightarrow 4Na$ (at Cathode)

Trial using KCl
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2Cl^{-1} \rightarrow Cl_2 + 2e^{-1}$ (at Anode/Cathode)
$4K^{+1} + 4e^{-1} \rightarrow 4K$ (at Cathode)

Trial using KOH
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2(OH)^{-1} \rightarrow H_2O + O^{-2} + 2e^{-1}$ (at Anode/Cathode)
$4K^{+1} + 4e^{-1} \rightarrow 4K$ (at Cathode)

Trial using $MgCl_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2Cl^{-1} \rightarrow Cl_2 + 2e^{-1}$ (at Anode/Cathode)
$2Mg^{+2} + 4e^{-1} \rightarrow 2Mg$ (at Cathode)

Trial using $Mg(OH)_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2(OH)^{-1} \rightarrow H_2O + O^{-2} + 2e^{-1}$ (at Anode/Cathode)
$2Mg^{+2} + 4e^{-1} \rightarrow 2Mg$ (at Cathode)

Trial using $ZnCl_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2Cl^{-1} \rightarrow Cl_2 + 2e^{-1}$ (at Anode/Cathode)
$2Zn^{+2} + 4e^{-1} \rightarrow 2Zn$ (at Cathode)

Trial using $Zn(OH)_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2(OH)^{-1} \rightarrow H_2O + O^{-2} + 2e^{-1}$ (at Anode/Cathode)
$2Zn^{+2} + 4e^{-1} \rightarrow 2Zn$ (at Cathode)

Trial using $CuCl_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2Cl^{-1} \rightarrow Cl_2 + 2e^{-1}$ (at Anode/Cathode)
$2Cu^{+2} + 4e^{-1} \rightarrow 2Cu$ (at Cathode)

Trial using $Cu(OH)_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2(OH)^{-1} \rightarrow H_2O + O^{-2} + 2e^{-1}$ (at Anode/Cathode)
$2Cu^{+2} + 4e^{-1} \rightarrow 2Cu$ (at Cathode)

Trial using $CaCl_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)
$2Cl^{-1} \rightarrow Cl_2 + 2e^{-1}$ (at Anode/Cathode)
$2Ca^{+2} + 4e^{-1} \rightarrow 2Ca$ (at Cathode)

Trial using $Ca(OH)_2$
$O_3 \rightarrow O_2 + O^{-2} + 2e^{-1}$ (at Anode)

$$2(OH)^{-1} \rightarrow H_2O + O^{-2} + 2e^{-1}$$ **(at Anode/Cathode)**

$$2Ca^{+1} + 4e^{-1} \rightarrow 2Ca$$ **(at Cathode)**

III. Conclusions:

In the present paper the mechanism of ozone and NaCl based electrolytic solar cell is presented in a different way. The mechanism is based on the galvanic effect. Instead of NaCl ionic solution it is also shown that one can also try using NaOH, KCl, KOH, $MgCl_2$, $Mg(OH)_2$, $ZnCl_2$, $Zn(OH)_2$, $CuCl_2$, $Cu(OH)_2$, $CaCl_2$, $Ca(OH)_2$ ionic solutions. This needs trial experimentation. This type of electrolytic solar cell is cost effective and also produces higher output and requires one third of area to establish the solar power plants if successful in developing the electrolytic solar cell.

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References:

[1]. James Bullock, Andres Cuevas, Christian Samundsett, Di Yan, Josephine McKeon, Yimao Wan. 2015. Solar Energy Materials and Solar Cells 138: 22-25.
[2]. Ryuji Oshima, Mitsuyuki Yamanaka, Hitoshi Kawanami, Isao Sakata, Koji Matsubara, Takeyoshi Sugaya. 2015. Journal of Crystal Growth 425: 162-166.
[3]. Liangqi Ouyang, Ming Zhao, Daming Zhuang, Junfeng Han, Zedong Gao, Li Guo, Xiaolong Li, Rujun Sun, Mingjie Cao. 2015. Solar Energy 118: 375-383.
[4]. Leonid Kosyachenko, Toshihiko Toyama. 2014. Solar Energy Materials and Solar Cells 120, Part B: 512-520.
[5]. Arturo Morales-Acevedo. 2014. Energy Procedia 57: 3051-3057.
[6]. Jung Woo Leem, Jae Su Yu, Dong-Hwan Jun, Jonggon Heo, Won-Kyu Park. 2014. Solar Energy Materials and Solar Cells 127: 43-49.
[7]. Chang Zoo Kim, Hogyoung Kim, Keun Man Song, Dong Hwan Jun, Ho Kwan Kang, Wonkyu Park, Chul Gi Ko. 2010. Microelectronic Engineering 87 (4): 677-681.
[8]. Routray S R, Lenka T R. 2018 CSI Transactions on ICT **6**83–96.
[9]. Routray S and Tenka T R. 2018 17(6) 1118-1124,
[10]. Maykel Courel. Appl. Phys. Lett. 2019 115 123901-123904 (2019)
[11]. Scharber M.C. and Sariciftci N.S. 2013. Progress in Polymer Science 38 (12): 1929-1940.
[12]. Brus V.V., Zellmeier M., Zhang X., Greil S.M., Gluba M., Töfflinger A.J., Rappich J., Nickel N.H. 2013. Organic Electronics 14 (11): 3109-3116.
[13]. Bin-Bin Ma, Yu-Xin Peng, Tao Tao, Jiao Geng, Wei Huang. 2015. Dyes and Pigments 117: 100-107.
[14]. Sung Jin Kim, Won Jin Kim, Alexander N.Cartwright, Paras N. Prasad. 2009. Solar Energy Materials & Solar Cells 93: 657–661.
[15]. Haotong Wei, Hao Zhang, Haizhu Sun, Bai Yang. 2012. Nano Today 7 (4): 316-326.
[16]. Dinesh Pathak, Tomas Wagner, Tham Adhikari, J.M. Nunzi. 2015. Synthetic Metals 200: 102-108.
[17]. Syed Mahboob, Rizwana and G. S. Kumar, 2021 Transactions on Electrical and Electronic Materials, 22(4): 536-542.