A NONCONVENTIONAL PRINCIPLE OF SOLAR PANELS USING SEQUENTIAL INTERRUPTION OF INCIDENT NATURAL LIGHT

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ABSTRACT: It is proposed a type of nonconventional solar panels, which does not have in their structure conventional solar cells, but photo-electrochemical reversible cells functionally organized in planar laminated structures made by coating, as functional electrochemical assemblies by anode-membrane-cathode type, exposed to intermittent natural light, being covered with a transparency and opacity window that succeed each other based on LCD (Liquid Cristal Display) technology using in dark phase, enabled by the opacity of the window, specific reactions at electrodes as electrochemical phenomena that generates electricity, and in brightened phase allowed through transparency of the same window, taking place the reversible photochemical reaction of decomposition of silver halide formed in the previous phase as a return to initial situation.
The active phase is the one produced in the dark in which electricity is generated and passive phase is at light when reactivation of the cell is happening, when the substances of the cell return to its original state. The reactions occur at the electrodes of the cells separated by ion permeable membranes.
KEYWORDS: photo-electrochemical cell, planar structure, layered deposits, porous electrodes, reactant, contact area, membrane.

1. INTRODUCTION

The topic of this study firstly , is, fundamental. As the largest energy resources and as ecological purity, sun and solar radiation can be considered as an ideal and eternal resource [13]. The actual solar energy conversion into electricity with devices manmade have very high manufacturing energy costs, remaining an expensive application. Although semiconductor based solar cells have a relatively high conversion efficiency, price performance ratio is low, because of high manufacturing price.

Although silicon solar cells, being already in circuit current use, are still a research subject, for reducing cost and increasing efficiency.

Inter and multidisciplinary research is necessary to find branches, even nonconventional, for obtaining electricity from solar light energy, to use structures and technologies with a price-performance ratio more convenient. Conveniently not so much by increasing conversion efficiency, as by reducing the manufacturing cost of photovoltaic devices, using technological materials with much lower energy consumption, by using recovered and recycled materials. It requires the storage of the obtained as impulses energy, in high-capacity capacitors and overflow in passive phases [11].

2. BASIC ASPECTS

During the operation of conventional electric cells, in order to generate electric power, it combines two or more simple substances, and it results some complex substances as a result of electrochemical reactions. When the process combination is complete and simple substances have been totally exhausted, going into the composition of composed substances that has been resulted, the electrochemical reaction stops, stopping also the generation of electricity. To recharge the cell it is needed to decompose composite substances resulted in initial simple substances. We remind that at the secondary cells, which are storage batteries, by decomposing into initial simple materials is achieved by passing a current through the cell from an outside source. But it is known that has been used in photography technique for over 150 years, a decomposition reaction, no electrical but under light reaction, of some complex substances, the most common being silver halides. For example:

$$2AgCl \text{ (photosensitive substance)} + \text{light} = 2Ag \text{ (metallic, powder)} + Cl_2 \text{ (gas)}$$

So, being a decomposition that can be relied on, achievable to light, would result in a possible theme: a cell using as reactants just simple substances in which silver halide decompose under the influence of light:

$$2Ag + Cl_2 \text{ (in the dark)} = 2AgCl \text{ (crystalline, solid)}$$

There is a further adjacent issue to be solved: reaction is symmetrical, that means, combination and immediately decomposed is happening under the influence of light. As combination-decomposition reaction to become non-symmetrical, it requires that the combining phase should take place in the dark, and the decomposition phase should take place at light. Before 1968 it was difficult to solve this problem, but when LCD technology started to be used, has become possible to perform electrical switching transparency and opacity of a window and to obtain dark at light. By using LCD technology are achieved needed phases of dark for combining silver with halide, resulting in silver halide, and at light to achieve the natural decomposition of silver halide in the halogen and silver.

Similar with the operation of the conventional electrochemical energy generators, the two reactants are combined together and resulting in a composed substance, the combination taking place in the special conditions provided by the structure of electrodes of the physical-chemical reactor structure that was designed especially as the anode-membrane-cathode assembly, for converting into useful electric current a part of the energy stored in the chemical bonds of the reactants. When one or both reactants are used up, the entire initial mass being found at least of one reactant in resulted compound substance the useful active electrical cycle stops. At the usual primary chemical cells after the reactant is used up, the permanent abandonment occurs, in the best case it is collected not to damage the environment. At storage battery, as secondary cells, it follows electric recharge, through which resulted compound substance it decomposes into initial reactants with more energy consumption than the energy debited by the storage battery at the optimum useful discharge. At the combustion hydrogen-oxygen cells, the substance (water) resulted from the electrochemical reaction which produced useful electricity there is a residue typically removed as waste.

Going reverse, based on the observation that silver halides decompose to light, it deserves designed and developed a new type of cell that silver halide to be the end product of an electrochemical reaction between two reagents, reaction which generated electrical current, and photodecomposition of the halide to be reversibility of the cell, that is, bringing the reactants to their original state before the electrical current to be generated.

Since the photodecomposition of silver halide is a photochemical process highly efficient using even low levels of illumination, as shown already in the classic obsolete photo technique, it deserves submitted any scientific efforts and applied research to achieve these photo-electrochemical structures to use as reagents silver and halogens, to generate electricity, followed by photochemical reversibility. Regeneration with inorganic substances is based on photo-dissociation of the reaction product in the reactor, which is then recycled to the cell [10].

Photochemical decomposition of silver halide is the real known phenomenon that deserves exploited, it took place probably on the resonance between the wavelength of light and the length of the path of valence electron of the chemical ionic bond silver-halogen. Matching the size of the wavelength and the resonance started up at the interaction of the photon of light with the composed substance of halide which permit the photons of light to break molecular bonds in a second stage, after in the first stage has been formed molecular bonds between the silver atom and the halogen atom under the conditions provided by the new photo-electrochemical structures which must be adapted for this purpose: generating electricity.

Other aspects related on electrochemical structure configuration, functional, reliable and necessary conditions for switching light-dark, are topics to be solved through intensive future research, as one half of the problem, because, for the other half consist of decomposition to light of silver halide is considered naturally solved, and is a known and well technologically mastered for over 150 years, in the photography technique. Basically, knowing the end of presumed electrochemical reactions which generate electrical power (halide), it has to be created the conditions to develop the process that generated the end, the conditions consist in existence of initial reactants as silver and halogen and useful interaction between them in the structure anode-membrane-cathode, with generation of useful external current. The reaction is reversible and symmetric when is happening under continuous light, because there is a immediate decompose the newly formed halide molecules by the light. It requires asymmetryzation of this reversible reaction.

Asymmetryzation can be achieved by introducing breaks into continuous light, that is, a sequence of states of dark-light-dark-light. Thus, the reactants will merge, taking place reactions between them in the dark and the light will separate immediately following the present phase.

Based on LCD experience, it can be created with extremely low power consumption, dark and light conditions by switching into opaque or transparent windows fitted with LCD.

3. CHARACTERISTICS FUNCTIONAL PHASES OF PHOTOELECTROCHEMICALREACTOR ANODE-MEMBRANE-CATHODIC

In Fig.1 shows the structure anode- membrane-cathode. The anode 1 according to fig.2 is made of silver foam, the cathode 2 is an "electrode of gas" with chlorine ions, a strongly electronegative chemical element. Membrane 3 is a membrane permeable to ions, being impermeable at neutral atoms. Window 4 is an LCD, which by external control becomes opaque or transparent.

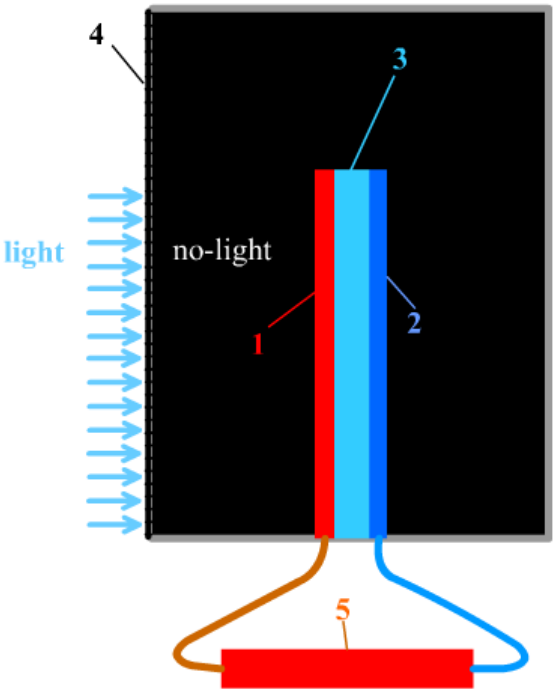

Figure 1.

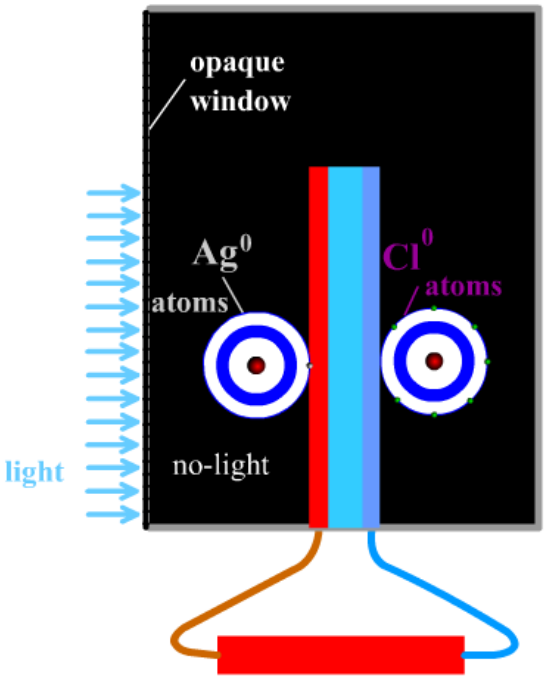

Figure 2.

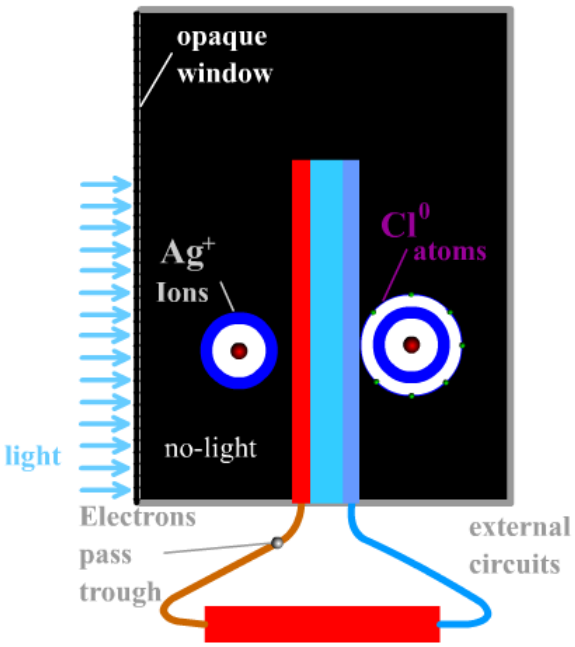

Figure 3.

According to Fig.3, in the dark, the silver atom from the anode having the extraordinary property to waive the electron valence, emit an electron which is flowing through the external circuit load.

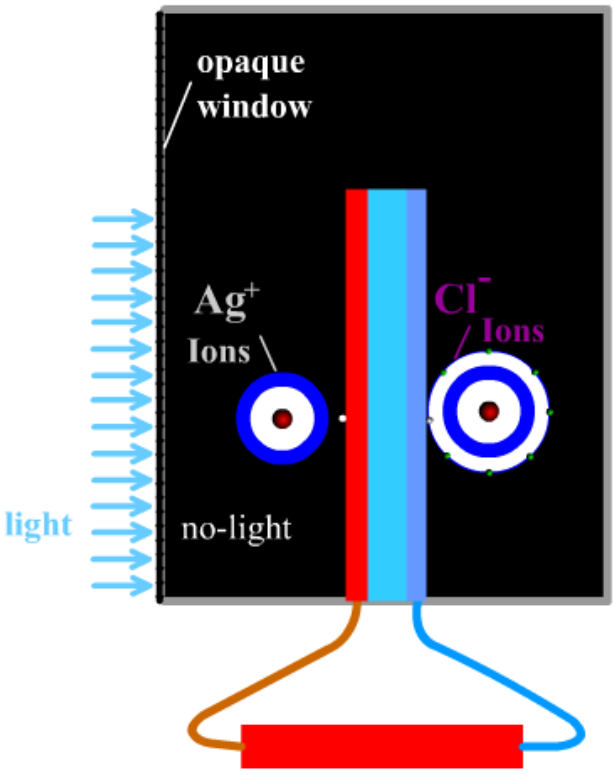

Figure 4.

According to Fig.4, in the dark, the electron is attracted by the porous cathode, and accepted by the chlorine atom becoming from chlorine atom into chlorine ion.

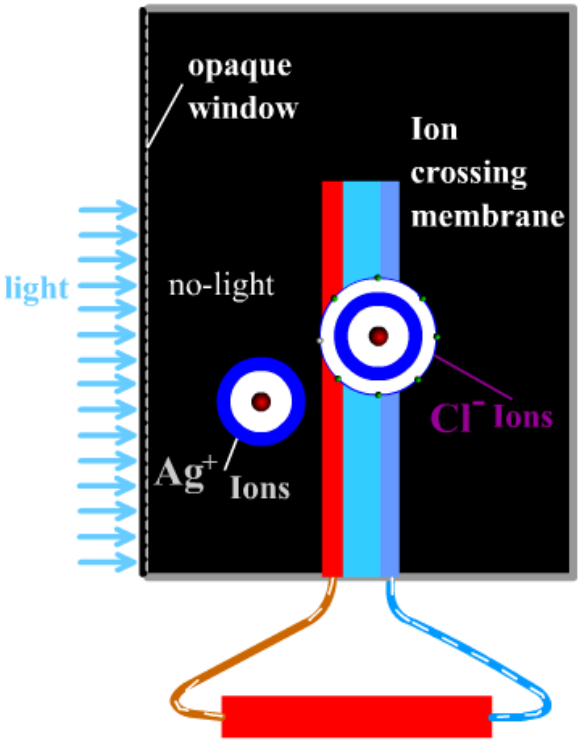

Figure 5.

According to Fig.5, in the dark, chlorine ion resulted from accepted electron is crossing the membrane permeable to ions, being attracted by silver positive ion from anode.

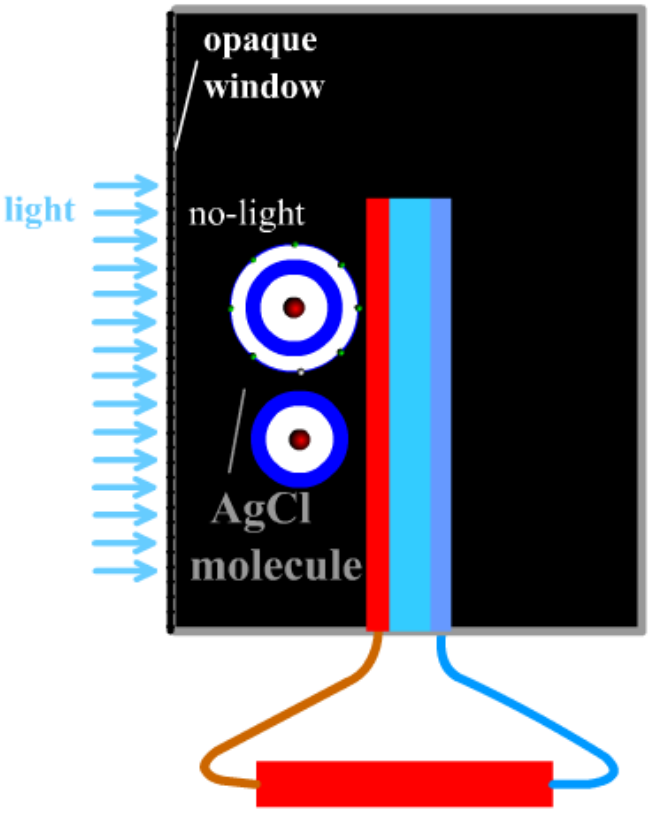

Figure 6.

According to Fig.6, in the dark, arrived in the area of porous anode, negative chlorine ion, encounters, by ionic attraction the silver positive ion resulting a molecule of silver chloride (AgCl) which is stable in the dark. Darkness is ensured by LCD window opacity in the path of light.

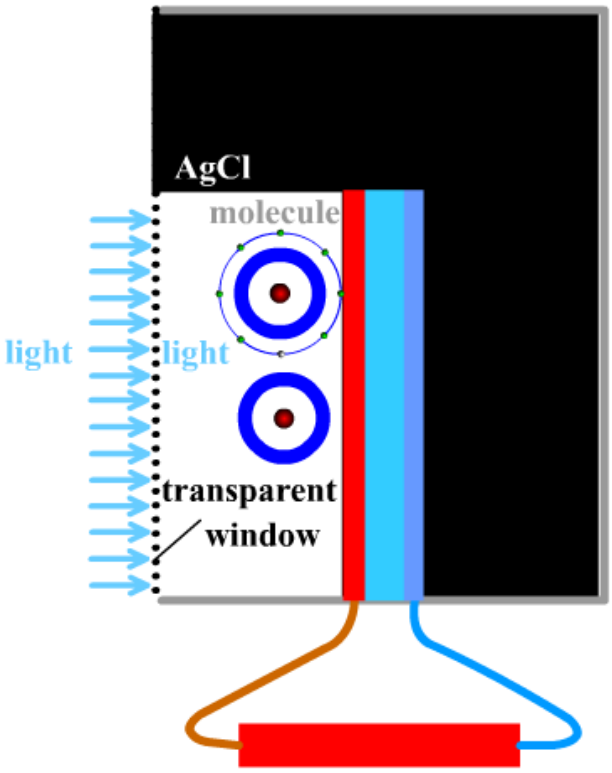

Figure 7.

According to Fig.7, in light conditions, after LCD window became clear (by external control), ambient light reaches the newly formed silver chloride and it break it.

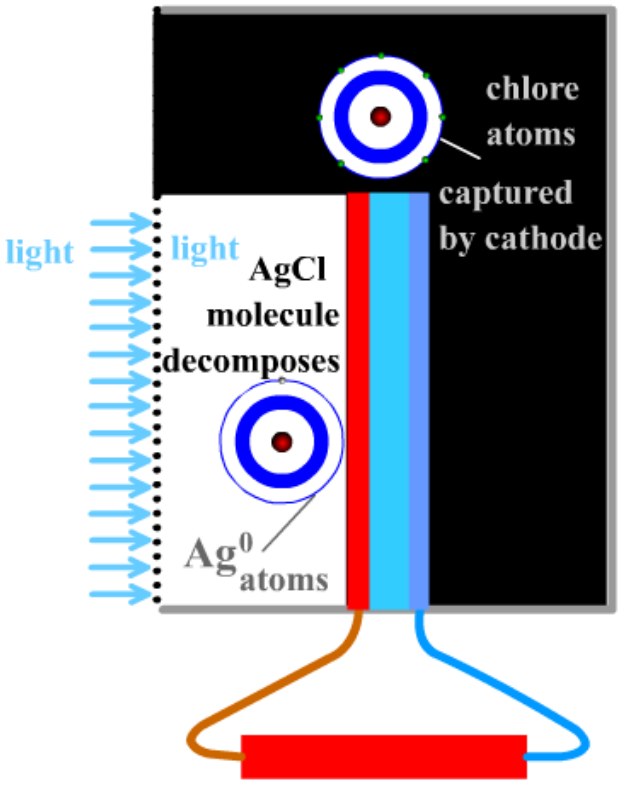

Figure 8.

As shown in Fig.8 silver chloride molecule has been split into component parts: neutral silver atom and the neutral chlorine atom. Neutral chlorine atom being a gas, is moving through available space channelled to the cathode.

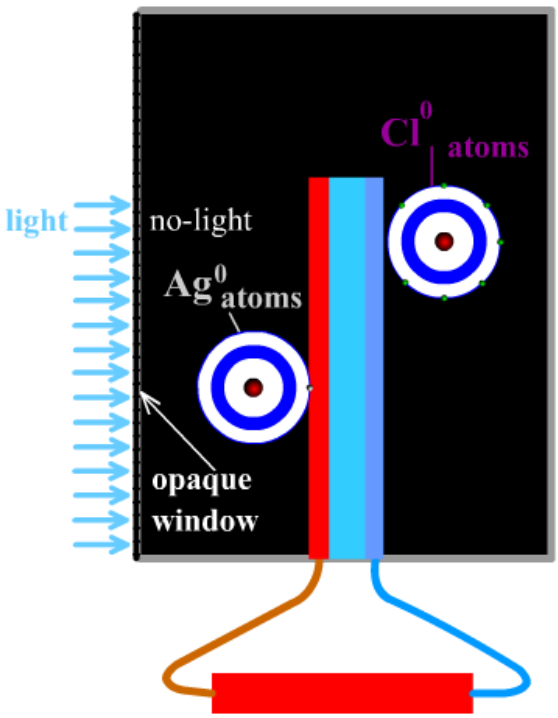

Figure 9.

According to Fig. 9, chloride ion being channelled to the cathode through space set up especially for this purpose, and reach again in the structure "electrode of the gas" which is the cathode, the initial start of the process similar to the situation described, when the transparent window 4 is opaque (via external control) and the processes that occur in the dark resumes, as showed in Fig.2

4. STRUCTURES OF REVERSIBLE CELLS PANELS

Reversible photo-electrochemical cells whose functional description has been made above in connection with Figures 1-8, can be made in large numbers on the same support, and by connecting them in series and in parallel may be solar panels, which have the same window transparent-opaque, common for entire panel, according to Fig.11. Fig.10 express the solar panel situation with the transparent window through which can be seen the cells components. The same situation is showed in Fig.11 but this time with opaque LCD window, situation where the panel is generating electricity at plus and minus terminals. In the situation represented in Fig.10, at light, the electricity is not generated, but here, the reactants are recovering, for the cells to be active and to be able to generate electricity in the following sequence, from the darkness. This is the most obvious aspect of nonconventional, because the panel generates energy in the dark phase, not the stage of lighting the cells.

The constructive design of the photovoltaic panel usable at final user would consist of planar layered structures of Nano metric thickness achieved by depositing, achieving cells as functional electrochemical assemblies of anode-membrane-cathode type, subjected simultaneously to the sunlight.

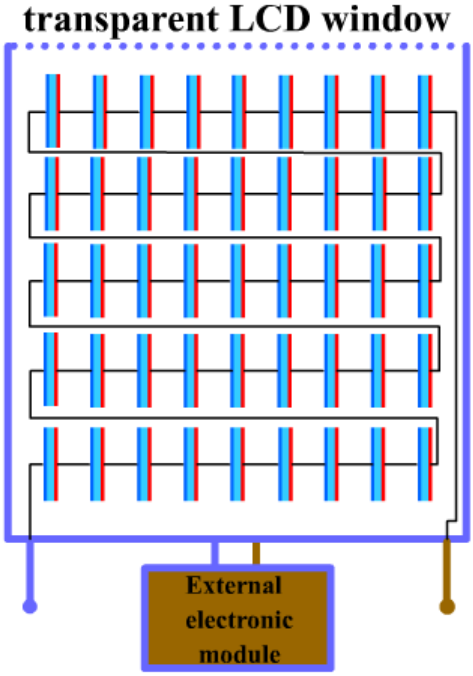

Figure 10.

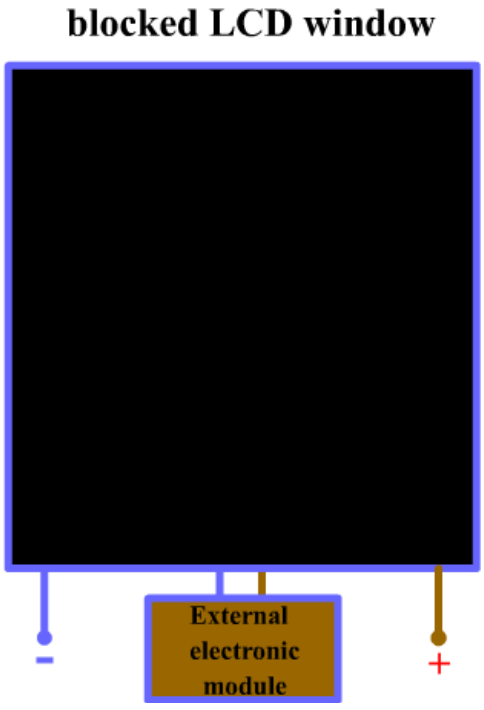

Figure 11.

The cathode as an porous layer with catalytic properties represents through its structure an extended contact area and the gas-solid interface between the halogen atoms and the electrons arriving from the external circuit through the electrode electrical contact [3]. At the cathode, in the dark, halogen atoms become negative ions accepting electrons arrived through the external circuit useful to consumers after they were transferred by silver atoms fine sprayed, from the structure of conductive anode polymer sintered and deposited as a top layer, ensuring on both sides of the membrane an electric field between the positive silver ions and negative halo ions. Solid electrolyte membrane being permeable at halogen negative ions allow them to migrate from the cathode to the anode on the shortest way to reach the porous mass of the anode where they combine with positive silver ions resulting silver halide. Under a new permitted lighting allow by transparency of the LCD window, silver halide (chloride) newly formed at anode absorbs the energy of light and allows the phenomena to be reversible, decomposing photochemical in metallic extremely fine spray silver and halogen (chlorine) gas that releases and create pressure occupying all small spaces, being free to reach the cathode, where the cycle begins again under the dark, obtained by the opacity LCD window of the entire solar panel.

Solar panels manufactured with such photovoltaic cells having a single window, providing successively and simultaneously opaque and transparent for all the cells that are electrically connected in battery, the control of subsequent opacity and transparency to get one exterior electronic module a few tens of times per second, to obtain a generated pulse in the dark phase.

Such a solar panel, once manufactured, is no longer powered with other reactants, but only with light and low power pulses for LCD.

5. EXPERIMENTAL RESULTS

At the experimental samples was used as a device for achieving distinct phases of light and dark an incandescent bulb of 75 W whose light fascicle, on his way to the reverse photo-electrochemical cell was blocked by the blades of a propeller rotating type fan, as showed in Fig.12. This propeller simulate transparency and opacity of a LCD windows.

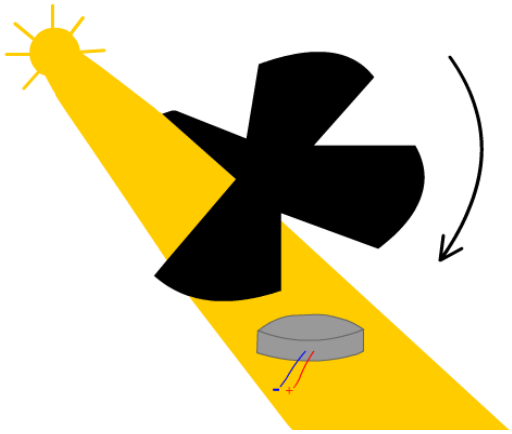

Figure 12.

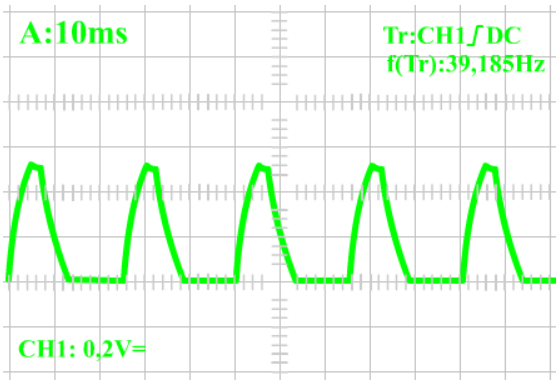

Figure 13.

As shown in Fig.13, voltage pulses obtained at electrodes of the cell, as expected, have no rectangular shape because of the relatively long mechanic-analogue switching of the light which scan the cell surface and there was not a digital switch from dark to light, such an LCD window will do.

The size of time (duration) of dark and light phases must coincide with the time of reactants reaction combination (in the dark) and decomposition of the halide (at light), a hard work to achieve due to the multitude of influence factors. But their inconsistency is not a "catastrophic", because from their inconsistency is results at most a amplitude limitation impulses generated by the cell and a change of their shape and pulse width obtained.

6. CONCLUSIONS

However nonconventional approach to a new branch to convert diffuse natural light energy into electricity, even if they require intermediary link of storage the energy daily into conventional batteries, it worth every scientific or fundamental effort, especially as applied. Efforts to achieve economic efficiency, reliability, the individual beneficiaries to be able to purchase more and more accessible, in the perspective for each house to have a panel or a battery of solar panels for domestic consumption and for its own electric car battery charging.

Once demonstrated that it is possible to create darkness in full illumination with LCD, it becomes possible this branch nonconventional energy-productive, even if they have to revolutionize even LCD, being in regress, applied in manufacturing TV, being raced by LED technique, such as to retain its transparency-opaque even lighting levels and thermal very high intensity. Such renewal of LCD technology will not be the only reconsideration, because it will be necessarily accompanied by reconsidering and restored to new life into the industry of materials with classic photos with photosensitive materials based on silver halide almost entirely recyclable after the normal life cycle development and use, at least for one decade of photoelectrochemical cell use based on reverse photovoltaic cell powered with successive pulses of light.

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