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HISTORY OF PHOTOVOLTAICS A REVIEW

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Abstract-*The present chapter describes about the history of the solar cell. Solar cell is widely used nowadays for the generation of electric power easily. Mostly increment of solar panel have risen up in the modern world. Solar cell is one of the most effective source of power generation that is going to serve us for a long time. PV cells use the sunlight and converts that into an electric power which can be used in many ways. Mostly the power which is obtained from the PV panels depends on the isolation..As the cost for generation of solar electricity has fallen down the grown of PV systems utility has increased. PV power generated can be used in industrial and domestic applications.*

Keywords- *Photovoltaic cells, Discoveries, Silicon, Sunlight, Experiments, Isolation, Solar Cells.*

I. INTRODUCTION

PV power is fluctuating power. It varies over the day, reaches the peak at noon and it is dependent on the isolation (solar power incident). It is not a fixed power. So, we need to use energy buffers like an battery for most of the applications. PV acts as an supplementing source. Solar power incident on the surface panel is directly proportional to the the photo current i_p. The generated solar power from PV panels can be synchronized with the grid for further applications. Solar power generated is variable so when synchronized with the grid power various transformations takes place.
PV cells use direct sunlight over a day and produce output maximum power with low cost, lower maintainence and pollution free. Mostly over the world, the PV system is used for the production of power rather than using non-renewable energy resources which is not economical. Fast response, robustness, Adaptability and higher reliability are some of the features for the PV system.

Various discoveries were done by the scientists by performing experiments and thus the invention of photovoltaic cell camed into existence.

II. HISTORY

A. DISCOVERIES BY SCIENTISTS.

In 1839, it began for the photovoltaic cells. A young boy 19 years old Edmond Becquerrel discovered PHOTOVOLTAIC effect and it came to be known as BECQUERREL effect. He came to be known as “Father of Photovoltaics”. The experiment was carried out by the Becquerrel in which container was filled with the acidic medium having two electrodes coated with AgCl, AgBr (silver chloride, silver bromide).He placed a thin membrane in between and connected the circuit. After that he showed light to electrodes and found that current is flowing in the circuit on the application of light. He experimented with blue ultraviolet sunlight and recorded all the observations. This was an early. Photovoltaic cell.

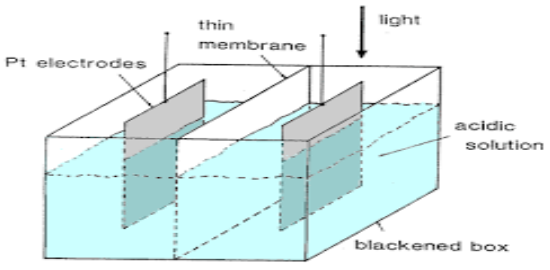

Fig. 1 Early Photovoltaic Cell

In 1877, Adams and Day published in the Royal Society “The Action of Light in Selenium”. Adam and Day made a Selenium photovoltaic Cell. Adams and Day took a vitrious selenium and to that they attached a platinum electrodes and was encased in glass tube. Light was incident on selenium through glass tube and observed that the current flowing in the electrode and the external circuit attached to it..This was the “Selenium Photovoltaic Cell”.

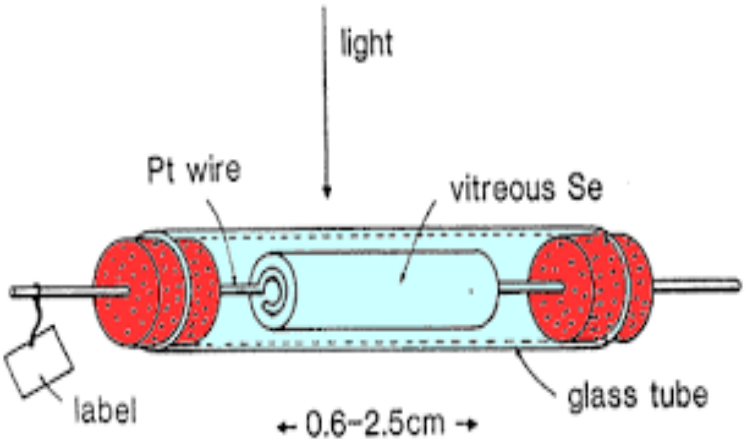

Fig. 2 Selenium Photovoltaic Cell

In 1883, Five years later, Fritts CE published in American Journal of Science " On a New Form of Selenium Photocell". This was the the first thin firm Selenium Solar Cell. It consists of Metal substrate (Brass). 25 micron selenium layer was pressed between two metal sheets. Above layer was Gold Leaf a very thin semi-transparent Gold layer whereas below layer was of metal substrate brass. Two contact were attached to which external circuit can be connected. A light was incident on the selenium through semi-metal and there was electric current flows through contact and external circuit. Even though it was demonstrated and performed well, researchers were not convinent about it. Even though experiments were reproduceable and repeatable he was not clear about the theory because at that time classical physics was not able to answer the underline theoretical principles of the operation of the solar cell.

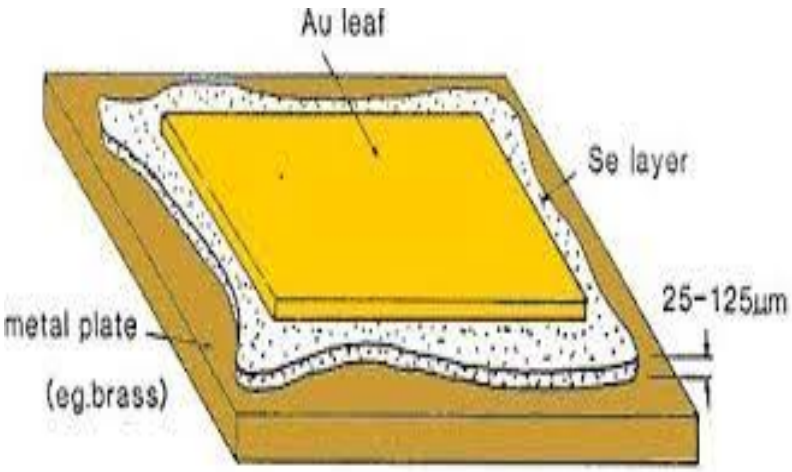

Fig. 3 First Thin Firm Selenium Solar Cell

In 1900, a revoluntionary happened a birth of "Quantum mechanics" on December 17,1900 Max Planck introduce
E=h .v
Where,
E=Quanta Energy (energy packets).
h=Planck constant
v=Frequency
The Quanta energy is directly proportional to the frequency. This was the starting point of amazing discoveries the window towards new the new world.

In 1905, Albert Einstein published "annalen der physik" and explained concept of photon(like quanta) packets. He explained the photovoltaic mechanism completely. This laid a foundation of semiconductor industry.

1916. № 7.

ANNALEN DER PHYSIK.

VIERTE FOLGE. BAND 49.

1. *Die Grundlage der allgemeinen Relativitätstheorie;* von *A. Einstein.*

Die im nachfolgenden dargelegte Theorie bildet die denkbar weitgehendste Verallgemeinerung der heute allgemein als „Relativitätstheorie" bezeichneten Theorie; die letztere nenne ich im folgenden zur Unterscheidung von der ersteren „spezielle Relativitätstheorie" und setze sie als bekannt voraus. Die Verallgemeinerung der Relativitätstheorie wurde sehr erleichtert durch die Gestalt, welche der speziellen Relativitätstheorie durch Minkowski gegeben wurde, welcher Mathematiker zuerst die formale Gleichwertigkeit der räumlichen Koordinaten und der Zeitkoordinate klar erkannte und für

Fig. 4 Annanlen der physik by Albert Einstein

In 1933, Grondahl LO worked and published many articles on "Copper Cuprous-oxide Solar Cell" and published numerous papers out of which "The Copper Cuprous-Oxide Rectifier and Photovoltaic Cell" became popular because low cost of production of that photovoltaic cell.

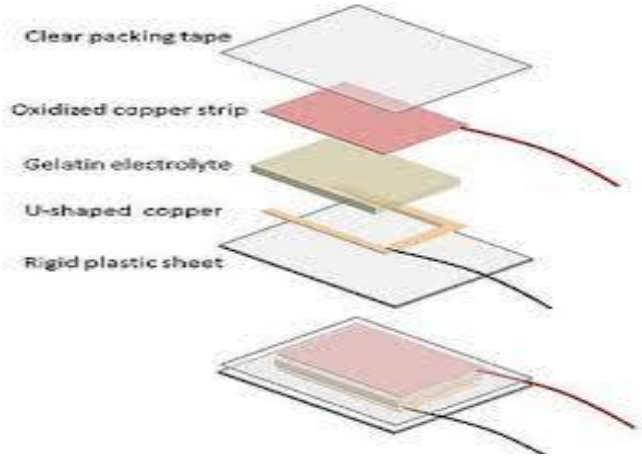

Fig. 5 Cuprous-Oxide Solar Cell

In 1941, Ohl made the first US patent for a "Silicon Solar Cell" having Light-Sensitive electric device including silicon. It was having Efficiency of much less than 1%.It did not have much commercial value or commercial implication but it was landmark for the photovoltaic cell. It was important point of the history.

Fig. 6 Silicon Solar Cell

In 1954, Chaplin D.M. , Fuller C.S. and Pearson G.L. published the "Journal of applied physics, 1954,25,676" A Silicon Solar Cell(Solar Diode).They found that silicon diode has an efficiency of 6% when sunlight is incident on it. This was the beginning of "Silicon Photovoltaic cell".
After that a rapid increment camed and there were host of solar cell being developed which can be used commercially.

Table 1. Types of Solar Cell

SOLAR CELL	*EFFICIENCY*
MONOCRYSTALLINE SILICON SOLAR CELL (MONO-SI)	***20%***
POLYCRYSTALLINE SOLAR CELL (MULTI-SI)	***18%***
THIN-FILM SOLAR CELL (TFSC)	***18%***

B. NOT IN COMMERCIAL INSTALLATION SOLAR CELLS.

- Gallium arsenide germanium solar cells (GaAs) -37%
- Copper indium gallium selenide solar cells -21%
- Cadium telluride solar cells (CdTe) -21%
- Amorphous silicon solar cells (a-Si) -10%
- Dye-Sensitized solar cells (DSSC) -11%
- Organic solar cells (OPV) -8%
- Multi-junction solar cells (InGAP/GaAs/InGaAs) -37%

C. FUTURE SCOPE OF SOLAR CELLS.

- Perovskite solar cells.
- Quantum dot solar cells.

♦ Pervoskite is material coated on silicon solar cell which improves efficiency another by 5%.
♦ Quantum dot solar cells are high efficiency solar cells.

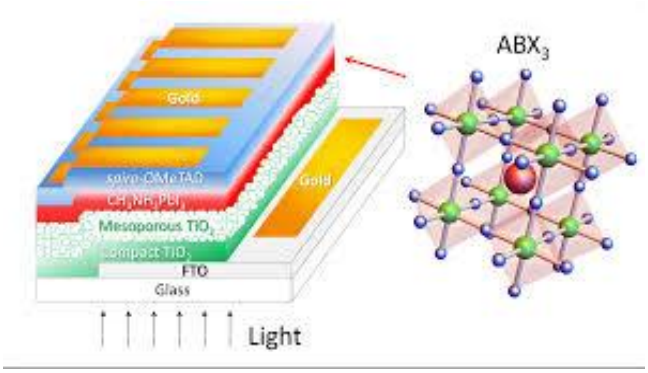

Fig. 8 Pervoskite Solar cell

Fig.9 Quantum Dot Solar Cells

III. SOLAR ENERGY MARKET

Solar energy market has widely increased over the world and it is excepted to reach $422 billion in 2022 from $86 billion in 2015.Solar energy has very much demand in power sectors and will at peak in upcoming years. Solar energy is an radiant energy obtained from photovoltaic cells and is one the most efficient form of unconventional energy. As seen from economical point of view solar energy generation is at highest point with no pollution in environment. Moreover the demand has increased due to low rate of solar panels and less cost of maintainence.

Fig. 9 Solar Energy Market

IV. Features and Advantages.

- It is faster and reliable than other power generating system.
- It is economical.
- It gives better characteristics and output response.
- The PV power can be synchronized with the grid power to get the maximum output.
- Fast response, higher stability and adaptability.

V. Applications.

- Earlier was used in Telephone repeaters
- Earliest used in Vanguard 1 Satellite 1958, 6-Si Cell Panels having Power P=5mW.When the battery stops operating after few months in the satellite the PV continued operating the transmitter for 6 years.
- Nowadays mostly used on the roof top.
- Used in Industrial and Domestic applications.

VI. Conclusion

Renewable energy sources can be used in many applications and maximum active power can be obtained from the Photovoltaic modules by controlling power through various devices and by transformations. History of photovoltaics can be known from the study and various solar cell with their efficiencies can be studied from the described chapter. Thus solar energy generated is completely the green process. Solar energy market increment in further years can be identified from the above chapter.

VII. Refrences

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