

# A REVIEW PAPER ON SOLAR ELECTRIC VEHICLES

RITVIK MALIYA<sup>1</sup>, MOHD NAZIM<sup>2</sup>, JP KESARI<sup>3</sup>

<sup>1</sup>Student, Dept. of Mechanical Engineering, Delhi Technological University, New Delhi

<sup>2</sup>Student, Dept. of Mechanical Engineering, Delhi Technological University, New Delhi

<sup>3</sup>Associate professor, Dept. of Mechanical Engineering, Delhi Technological University, New Delhi

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**Abstract** – Greenhouse effect is major issue in present time. Solar electric vehicles are pollution free and safe for our environment. Solar energy is renewable source of energy. Solar panels are attached on the top of our solar vehicle which contains many solar cells. These solar cells convert solar energy into electrical energy by photovoltaic effect. Batteries in solar electric vehicles should be chosen carefully because a good battery has more energy capacity. The first solar car was made by William G. Cobb of General Motors which he named sunmobile. There are some limitations in solar cars which can be overcome by advancement in future technology.

## 1. INTRODUCTION

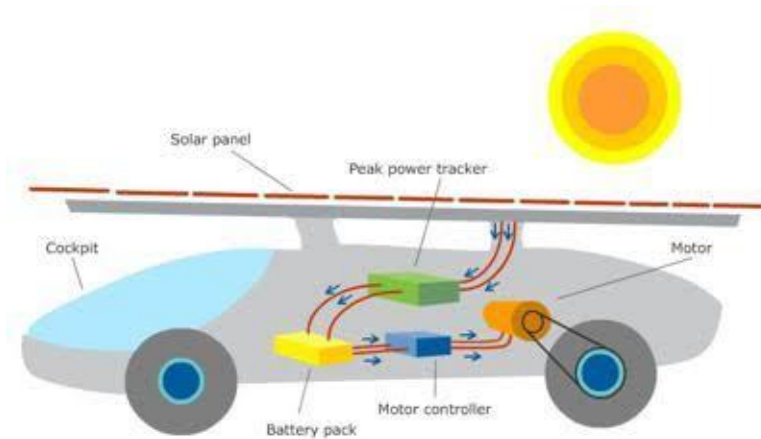
Solar electric vehicles are the future of automobile industry because it requires renewable and sustainable form of energy. Solar vehicles are the electrical vehicle that uses photovoltaic cells to convert solar energy from sunlight to electrical energy. Solar vehicles are also known as green vehicle because it prevents environmental pollution. Initial cost of solar vehicles is high but requires less amount of money to maintain because solar energy is unlimited and free. Battery system in it provides high energy storage to our vehicle. Solar cars are used world widely for races. World solar challenge is a world famous competition of solar cars which is held every 2-3 years from Darwin to Adelaide in Australia. The average speed at 1987 World Solar Challenge was 67km/h and winner speed was 91km/h.

## 2. History of Solar and electric vehicles

The first solar car was created by William G. Cobb of General Motors Corp. It was 15 inches long car. Sunmobile was the first solar vehicle. William Cobb demonstrated Sunmobile at General Motors Powerama auto show held in Chicago, Illinois. He used 12 photoelectric cells made of selenium in Sunmobile. World solar challenge was created by Hans Tholstrup. He was born in 1944. Larry Perkins helped him to drive his first solar car 'Quiet Achiever' between Sydney and Perth in 20 days. The first World Solar Challenge was held on 1987 at Australia. It was a 3022 kilometres race from Darwin, Northern Territory, to Adelaide, South Australia. Since 2001 Nuna team and cars of Delft University of Technology won WSC seven times. The first electric vehicle was created in 1832 by Robert Anderson. The first electric vehicle in U.S. was debuted around 1890. In 19<sup>th</sup> century many French and English inventors built some practical electric cars. Electric cars were easy to drive and not harmful for environment. Later Porsche developed a hybrid car powered by gas engine and electricity.

## 3. COMPONENTS OF SOLAR CARS

There are various components used in solar electric vehicles.



### 3.1 Solar Panels

Solar panels are attached on top of the vehicles. Solar panels generate DC electricity as sunlight stimulates electrons to move through solar cells. Solar cells are built into the solar panels. Solar panels help in absorbing solar energy and converting it into electrical energy. Solar panels contain photovoltaic cells, which help to generate electricity from sunlight by the photovoltaic effect. These cells are made of semi-conductive material, which helps in the electrical imbalance required to set up an electric field. Photovoltaic cells are arranged in a grid-like pattern. Photovoltaic cells are like modules that can be made by the connection of 32, 36, 48, 60, 72, and 96 solar cells. Solar panels help in reducing the greenhouse effect and global warming.

### 3.2 Solar Cells

Solar cells are photovoltaic cells. "Photo" means light and "Voltaic" means electric current. A solar cell converts solar energy into electrical energy by the photovoltaic effect. When sunlight reaches the solar cells, electrons absorb energy from photons and start moving freely. Semiconductors present in solar cells help in creating a magnetic field, which helps electrons flow in a certain direction. The movement of electrons creates an electric current.

### 3.3 Solar Array

A combination of solar panels forms a solar array. Sunlight hits the solar panel, which converts it into DC electricity. The solar array is connected to an inverter system, which helps in changing DC electricity to AC electricity. The design of the solar array is the most important factor because a bad design can reduce the life time of the solar array. Solar arrays should be in a position where they get maximum sunlight. Any shade or light obstruction can reduce their effect.

### 3.4 Power Trackers

Power trackers convert the solar array output into the proper voltage, which can be used by the battery. Power is automatically adjusted to match the system voltage, which allows the system to run as efficiently as possible. In the absence of power trackers, the DC motor system would result in poor performance.

### 3.5 Electric Motors

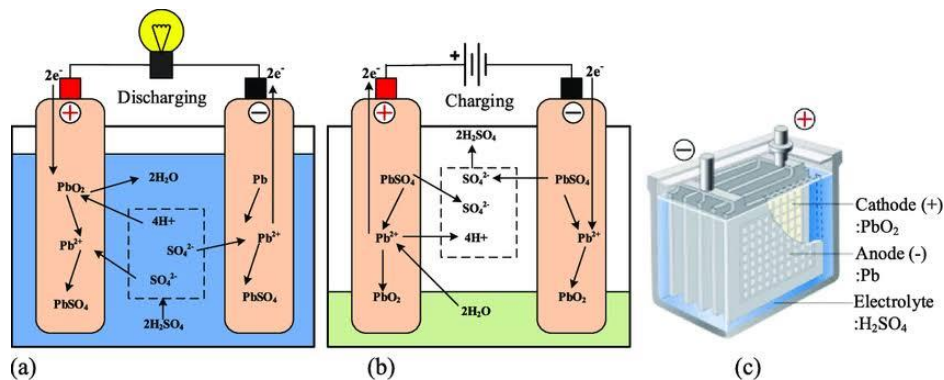
Electric motors convert electrical energy into mechanical energy. When the electrical energy from the car battery is supplied to the motor, the coil creates a rotating magnetic field that pulls the conducting rod outside of the rotor. The spinning rotor creates the mechanical energy, which is needed to turn the gear of the car, which, in turn, rotates the tires.

### 3.6 Battery

Battery in solar cars stores the solar energy in a chemical form when the motor is not running. Batteries provide stable power to DC motors and as the result, the motor will work more efficiently without any interruptions. There are various types of batteries which can be used in solar electric vehicles. Some of them are lead acid, lithium ion and nickel iron batteries.

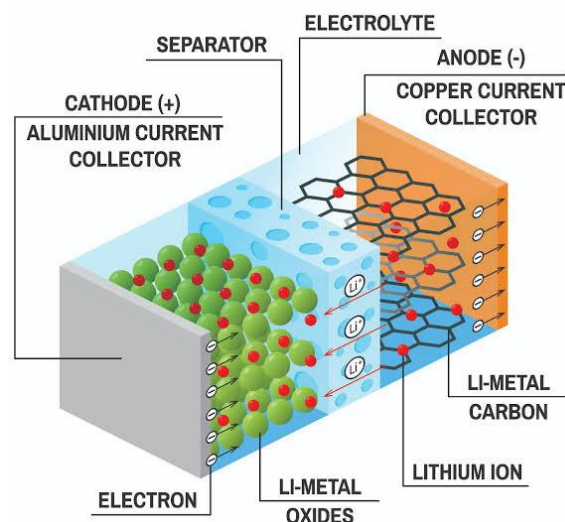
#### 3.6.1 Lead Acid Battery

It is a common automobile secondary battery. It contains cathode of lead oxide, anode of lead plate and electrolyte of sulfuric acid. Lead oxide helps in oxidation of lead plate. Lead acid cells are arranged in the form of grid which helps in producing and equally distributing electric current. These are the cheapest rechargeable batteries.



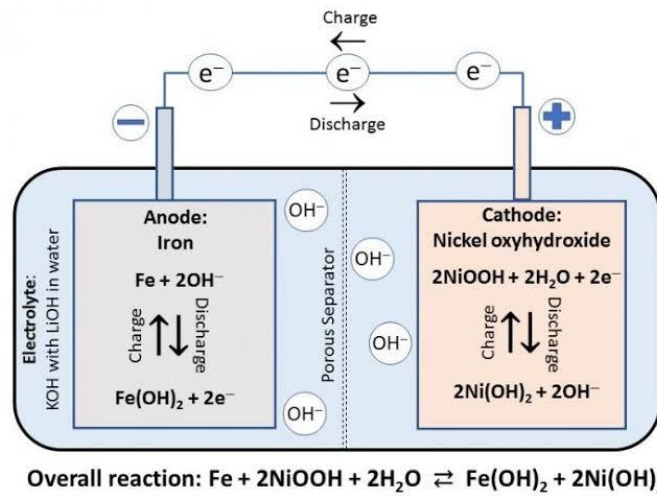
#### 3.6.2 Lithium ion Battery

This battery is made up of cathode, anode, electrolyte, current collectors and separator. In electrolyte positively charged lithium ions moves from anode to cathode. Their movement helps in electron flow which creates the electric current. Electric current flows from collector and separator helps in blocking electrons flow inside the battery. Their life cycle is longer than the traditional batteries and they also have high charge and discharge rates.



#### 3.6.3 Nickel Iron Battery

In it Nickel hydroxide is used as cathode and iron is used as anode. Our electrolyte is of potassium hydroxide. Nickel hydroxide, powdered iron and its oxides and are the active materials. Its life span is also longer than lead acid battery. It contains both positive and negative plates. These plates consist of rectangular grids of nickel plated iron.



#### 4. CONCLUSION

Solar cars future is quite bright and it will bring advancement in technology. It provides unlimited energy, low fuel cost is required and it is ecofriendly. Solar cars batteries are very expensive and there initial cost is high. Large surface is required on the top of our vehicle to mount the solar panel. Energy capacity is limited in solar electric vehicles and they are limited to solar energy. There are some cons of solar cars which can be overcome with advancement in future technology.

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