

## Thermoelectric materials in hybrid cars

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**Abstract:** Due to the ever growing demand for alternative energy fuel sources, hybrid cars are gaining importance in this current century. In order to achieve greater efficiency in hybrid cars, automobile companies are investing heavily in research and development. Need for conservation of energy is necessary for achieving greater efficiency in hybrid vehicles. In this context, thermoelectric materials play a very important role. The main objective of this paper is to analyze an improved method of recharging the batteries in hybrid vehicles using a ceramic coated cast iron bar with an inner lining of fiber glass material inside to which a bismuth telluride bar is placed, is fitted to the cylinder head of the gasoline engine. The electricity generated is given to the battery which makes it charge at a faster rate.

**Keywords:** Bismuth telluride, fiber glass.

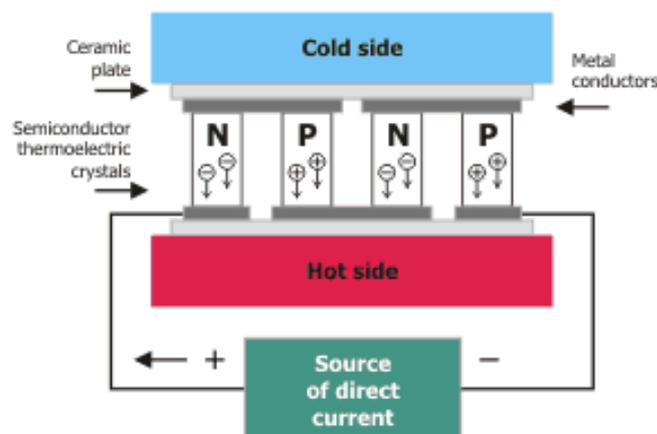
### I. Introduction:

The hunt for environmentally friendly vehicles has been on for quite a while now. Alternative sources of fuel (such as biodiesel and hydrogen) reduce tailpipe emissions from internal combustion engines. Electric vehicles are not much good either in the real world, although there are no emissions from them, they have a limited drivable range and the batteries take way too long to recharge. To overcome the drawbacks of an electric vehicle, the hybrid vehicle was created. Hybrid vehicles feature a power train that includes a traditional internal combustion engine as well as an electric motor, batteries and a generator. The batteries in hybrid cars are responsible for the better fuel economy. They power the electric motor, which typically propels a hybrid car at lower speeds. Some varieties use their internal combustion engine to generate electricity by spinning an electrical generator to recharge their batteries. By extracting heat from the cylinder head (engine) and converting it into electricity, the batteries can be recharged at a faster rate.

#### Usage of bismuth telluride for generation of electricity:

Bismuth telluride is a compound of tellurium and bismuth. When alloyed with selenium or antimony, it acts as an efficient thermoelectric material suitable for portable power generation. Bismuth telluride crystals bear a remarkable quality. If, being prepared in a certain way semiconductor  $\text{Bi}_2\text{Te}_3$  crystals (they are also called pellets) of the n- and p-types of conductivity are alternatively joined sequentially with each other by metal conductors, and this being placed between two thermal conductive surfaces, resulting in the production of electricity through the direct conversion of heat.

#### Generation of electricity using bismuth telluride crystals

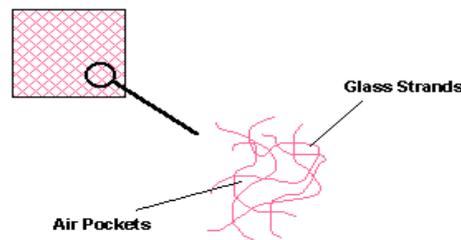


#### Need for fiberglass:

For a particular gasoline engine a figure for the average temperature in the cylinder during combustion stroke is  $820^\circ\text{C}$ . Near the walls the temperature is closer to the engine block and cooling system temperature,

but in the middle of the flame it might be from 1650-2750°C (3000-5000°F) with 1950°C more likely. This temperature can melt the bismuth telluride bar which is placed inside the plate. Due to this, an insulating medium more like a heat reduction medium is necessary for the process. Most of the engines are coated with ceramic to provide protection to the cylinder head and the engine. In spite of this layer of coating, an extra layer of fiberglass is placed inside the inner walls of the metal plate to provide protection to the bismuth telluride bar. Fiberglass insulation is made from very fine strands of glass held together in a thick, random layer. Between the fibers are many small pockets of air. The glass strands themselves are very poor conductors of heat. Thus the heat entering the metal plate is reduced.

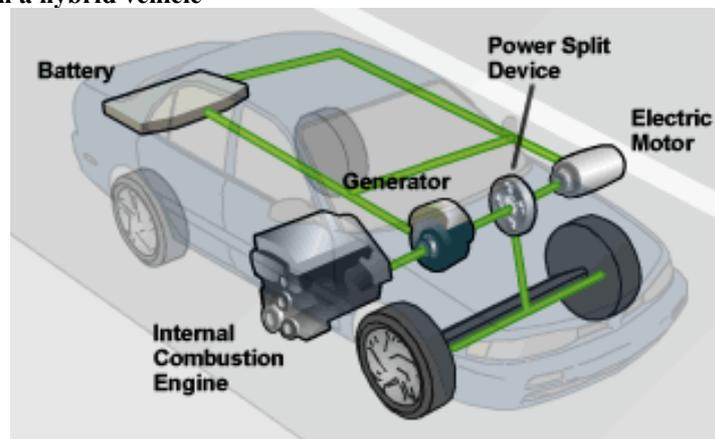
### General Fiberglass material



### Working of a hybrid car:

A hybrid car makes use of both gasoline (internal combustion engine) and electric motors for propulsion, switching between the gasoline engine and electric motors while the car is in motion to maximize efficiency. The defining feature of a hybrid car is the rechargeable energy storage system (RESS). Because this system is recharged by the processes of operating the car, it does not have to be "plugged in" as does a battery electric vehicle. Regenerative braking, converts some of the car's kinetic energy into energy stored by the battery or capacitors. Energy can also be generated and stored by an electrical generator operated by the engine. Hybrid cars do not require operators to make decisions about fuel source; instead, this is determined by the speed of the car. Generally, when the car starts up and at low speeds, power from the electric motor is used, while the ICE is engaged for higher speeds.

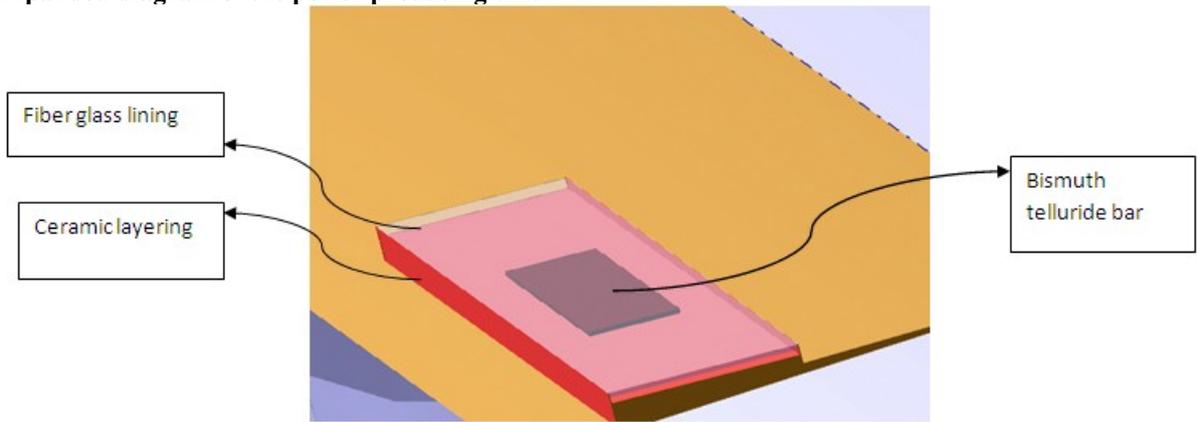
### Basic parts present in a hybrid vehicle



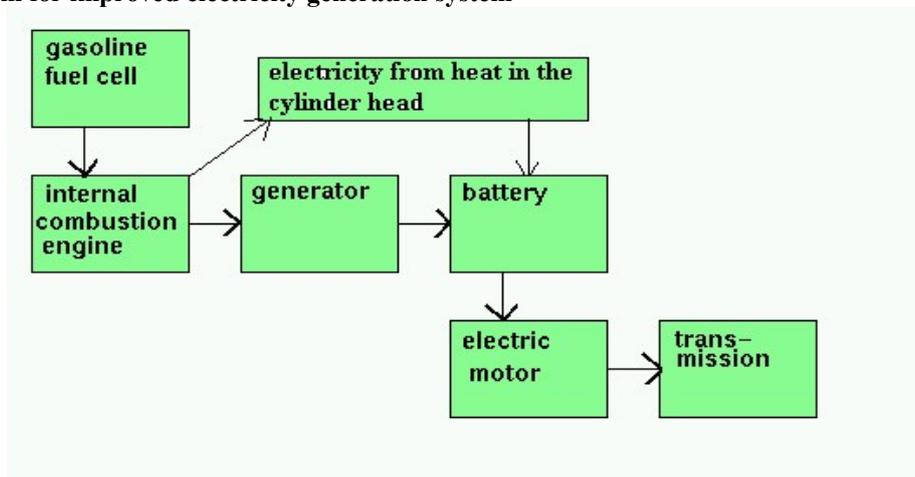
### Improved method for faster recharging of batteries:

To facilitate faster recharging, a ceramic layered cast iron bar is taken and is fitted to the top of the cylinder head. The ceramic layering is provided to act as a thermal barrier coating. This bar is provided with an inner lining of fiber glass which acts as a heat reduction barrier. Inside to this, bismuth telluride bar is placed. Being a thermoelectric material, it absorbs the heat from the cylinder head and converts it into electricity. Tungsten wires are suitably provided for extraction of electricity and feeding it into the battery thus enabling recharging at a faster rate. This method can be used in addition to the electricity captured from regenerative braking and in combination will be able to regenerate the batteries which power the vehicle at lower speeds.

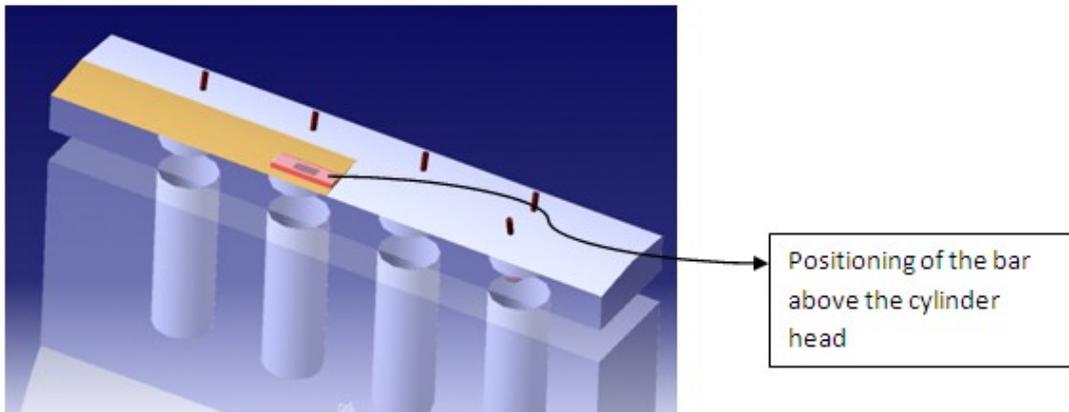
Expanded diagram of the power producing unit

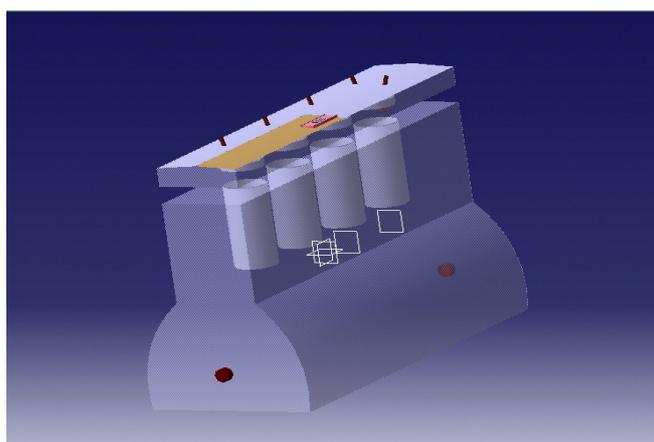
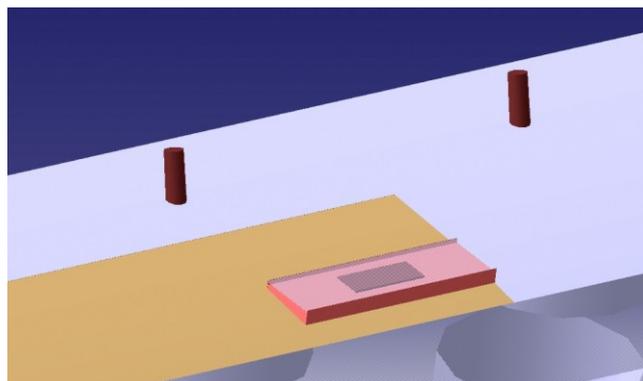


Flow diagram for improved electricity generation system



Other diagrams:





## **II. Results:**

By using the proposed method, there is a definite increase in the rate of recharging of batteries present in the hybrid vehicle. Moreover, this method can also be used in gasoline powered vehicles to generate electricity which can be used to power head lights, dash board etc. This method will undergo fabrication soon.

## **III. Conclusion:**

The growing need for an alternative energy source is forcing us to shift towards hybrid vehicles and there is an even greater debate on the efficiency of the hybrid vehicles. Implementing this method can tilt the debate on the side of the hybrid vehicles and favor a green environment.

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