

Review on Micro Power Energy Harvesting by Using Smart Materials

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Abstract - Energy is one of the most important things in this century. Energy is essential for the powering business, industrialized and the shipping of good and service to serve world economies. The running most of our appliance and to carry out daily work we need electricity. It's really very difficult to imagine our life without electricity, our life would really stop so there is high need, to produce electricity and find some other feasible method to produce electrical energy. Now day's people have been an increases demand on low power and portable device like smart phone, IPods, etc. Therefore then need low power and portable energy source. In this scope piezoelectric and thermocouple materials become strong devices for energy generation and use in future applications. In this review paper discuss the use of piezoelectric and thermocouple for natural energy harvesting for a low power consumption.

Keywords: Piezoelectric material, thermoelectric material, harvesting energy.

I. INTRODUCTION

In electronics market there is variety of devices are available which work on low power supply. Therefore high requirement of portable low power supply device like mobile phones charger. This entire device needs a compact low cost and lightweight energy source, which enable the desire portability and energy autonomy. Now days, economic growth of India is rapidly increased, therefore India goes towards developed country. India developed road infrastructure due to this road traffic has been increased. Vehicle on road increased, noise pollution increased by using there unwanted noise we can generate electricity using transducer. Economy rate of family is increased therefore people use L.P.G gas for cooking food and also in hotel L.P.G gas for cooking. We can convert this heat into electricity using basic principle of thermocouple.

R. J. Littrell [1], say the Piezoelectric material use for the high performance microphone, that means the piezoelectric martial use for reverse that is convert the sound energy to electrical energy. T. Dikshit et.al [2], work on energy harvesting is to use of piezoelectric material that can convert the ambient vibration surrounding energy into electrical energy. Takeuchi, M. [3], a piezoelectric power generator or harvester can convert impact energy from various mechanical vibrations of daily life into electrical energy. Roundy S. et.al [4], the conversion of vibrations is the best or most versatile method to scavenge ambient power in low amount by using the piezoelectric material. R. Vullers et.al [11], in the field of thermal, motion, vibration

and electromagnetic radiation energy harvesting has yield increasing power output and smaller embodiment. Power management circuits for rectification and DC-DC conversion are becoming able to efficiently convert the power from these energy harvesters in small amount.

II. HARVESTING ENERGY FROM UNWANTED SOUND AND VIBRATION

Now day's countries like India are going to develop their own infrastructure. Almost all the people are using vehicle. This vehicle makes noise pollution on the road, highways. In this century the most common thing we encounter everywhere like highways, industries, bus stand is noise pollution. So naturally one thing comes in our mind whether is it's possible to convert sound energy to electrical energy? And this unwanted sound of road, industries, and bus stand could be converted and use for some productive purpose. Also many machines make unwanted vibration, this vibration we can convert into electric energy. Let see how this can be possible.

According to low of thermodynamic mechanical energy could be converted into electric energy. We know sound energy is in the form of mechanical wave. So this mechanical sound waves and oscillation of pressure this pressure created by the sound could be used to convert it into electric energy. Also vibrations have a pressure. Piezoelectric material converts mechanical pressure into electric energy this property of piezoelectric material could be used to making device which would be able to convert possible amount of sound energy and vibration energy to electric energy as piezoelectric material convert sound energy to electric energy.

A. Concept of piezoelectric material

Piezoelectricity discovered by curies brothers in 1880. The original meaning of word piezoelectric is pressure electricity the generation of electric power from applied pressure.

The piezoelectric effect is a special material property that exists in many single crystalline material such as, Quartz, Rochelle salt, Barium, Titanate, Topaz, Tourmaline, Cone sugar, Berlinite, bone, tendon, silk, enamel, dextin lead titanate, potassium niobate etc. Where crystal is placed between a solid bone and the force summing member the

sound energy could be convert into electricity using piezoelectric material. Let us see the properties and characteristic of piezoelectric material.

B. Working of Piezoelectric Material

Direct piezoelectric effect:

When stress/pressure is applied generation of electricity.

Inverse piezoelectric effect

The generation of electricity is stress and/or strain when an electric field is applied. When a piezoelectric crystal is placed in an electric field, tension applied or compression pressure on piezoelectric material then we get voltage across piezoelectric material.

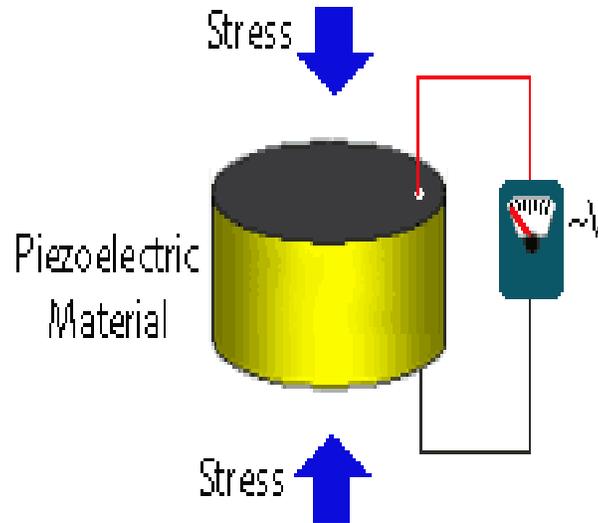


Fig.1 Piezoelectric effect

When the directions of applied pressure are reversed or converse this is called converse piezoelectric. Now the sound energy and vibration energy, pressures apply on piezoelectric material. It creates pressure on the

piezoelectric then it reverses it and the pressure is converted into electric energy. The direct piezoelectric effect property of a piezoelectric could be used for the making the device to convert sound and vibration energy to electrical.

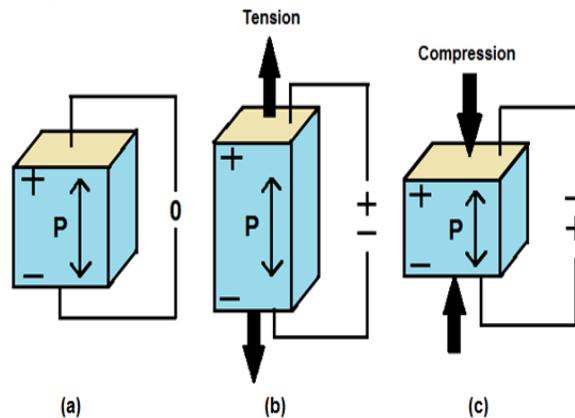


Fig.2. Piezoelectric effect

III.HARVESTING ENERGY FROM WASTE HEAT

Now day's population is going increases thus the economy rate of family is increases therefore people use L.P.G gas or other device for cooking, also population causes number of hotel are increases they also use L.P.G gas for cooking. Most common thing we see everywhere like home, hotel, industries there heat used for work, so idea comes in our mind whether is its possible to convert heat energy into electrical energy?. And this heat use for dual purpose that is cooking and produce electrical energy too, in industries work and electric energy production. Let see how it is possible. We know heat energy is in the form of

temperature. This temperature we can convert into electrical energy production. Thermocouple material is use for the convert het energy into electrical energy in possible amount.

A. Concept of thermoelectric material

Thermocouple is one type of temperature measurement transducer. Thermocouple is a pair of two dissimilar metal wire joined together at one end. It's produce potential difference between hot and cold function. The magnitude of the thermal emf depends on the wire material used in the temperature difference between the two junctions between two dissimilar metals or metal alloys ex. Cu and Fe is a function of temperature.

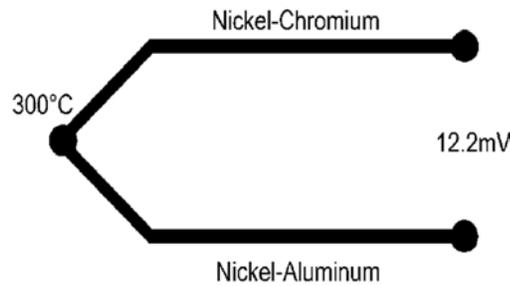


Fig.3 Thermocouple

B. Working Principle

Seebeck Effect:

“Seebeck effect states that when two different metal or dissimilar metal joined together at two junctions an electromotive force (emf) is generated at the two junctions. The amount of the emf generated is different for different combinations of the metal”.

In order to archive higher voltage, the thermocouple can arrange in series. The energy thus obtained is stored in batteries. Thus the working principle behind thermocouple is energy harvesting system.

IV. FUTURE APPLICATION

- i. The sound pollution in the road converts into electric energy to use for signals, lightning on road by using piezoelectric material.
- ii. The sound pollution in industries used to produce electrical energy.
- iii. The lost heat in home, hotel, and industry could be used to convert electrical energy and use for low voltage apparatus.

V. CONCLUSION

- i. As sound and heat more amount energy with it, it could be used by converting into electric energy for various purposes
- ii. According to law of thermodynamics sound energy could be converted into electric energy
- iii. Piezoelectric crystals are which converts sound energy to electric energy
- iv. Two dissimilar materials are which converts heat energy to electric energy.
- v. Lot of research is to be done on piezoelectric and thermoelectric materials but on positive note this could surely be done which could solve the

energy problem of the entire world in small amount.

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