PIEZOELECTICITY AND ITS APPLICATIONS

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ABSTRACT

The generation of electric field by applied pressure. It is observed in crystalline materials with no inversion symmetrical Piezoelectric ceramic materials are not piezoelectric until the random ferroelectric domains are aligned by a process known as POLING. When pressure is applied to an object, a negative charge is produced on the expanded side and a positive charge on the compressed side. Once the pressure is relieved, electrical current flows across the material. The output voltage obtained from a single piezoelectric crystal is in milli-volt (mV) range, which is different for different crystals. In order to achieve higher voltages, the piezoelectric crystals can be arranged in series. In this project the power is generated low voltage so this will be convert to higher voltage by using series voltage low (KVL)[3].

Keywords: Electric Double Layer Capacitors (EDLC), Direct Current (DC) , Alternating Current(AC), *Super Capacitor (SC)*, Lead Zirconate Ttitanate (PZT).

1. INTRODUCTION :

In which report the generation of electric field by applied pressure. It is observed in crystalline materials with no inversion symmetrical Piezoelectricity was discovered by Curie brothers in 1880. The materials exhibiting the direct piezoelectric also exhibit the reverse piezoelectric effect[2] (The internal generation of a mechanical strain resulting from an applied electrical field). Piezoelectric ceramic materials are not piezoelectric until the random ferroelectric domains are aligned by a process known as POLING. When pressure is applied to an object, a negative charge is produced on the expanded side and a positive charge on the compressed side. Once the pressure is relieved, electrical current flows across the material. The output voltage obtained from a single piezoelectric crystal is in milli-volt (mV) range, which is different for different crystals. In order to achieve higher voltages, the piezoelectric crystals can be arranged in series[6].

WORKING PROCESS :

1. The positive & negative charges are symmetrically distributed in a crystal.
2. Piezoelectric ceramic materials are not piezoelectric until the random ferroelectric domains are aligned by a process known as POLING.
3. Poling consists of inducing a DC voltage across the material.
4. When pressure is applied to an object, a negative charge is produced on the expanded side and a positive charge on the compressed side[4].

Once the pressure is relieved, electrical current flows across the material.

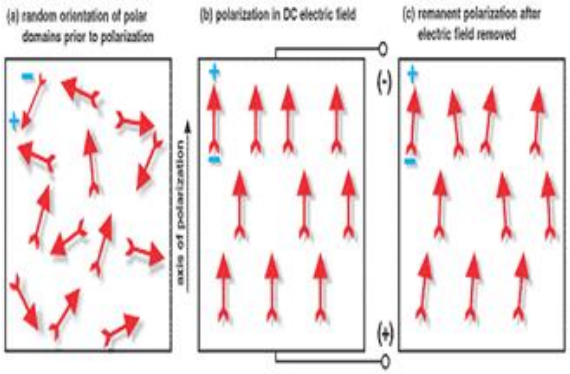

Fig:1. (a) Random orientation of domains prior to poling

(b) Poling in DC Electric Field

(c) Remnant polarization after field is removed [6].

USED MATERIAL:

NATURAL	SYNTHETIC
Quartz	Lead zirconate titanate (PZT)
Rochelle Salt	Zinc oxide (ZnO)
Topaz	Barium titanate (BaTiO3)
Sucrose	Gallium orthophosphate (GaPO4)
Tendon	Potassium niobate (KNbO3)
Silk	Lead titanate (PbTiO3)
Enamel	Lithium tantalate (LiTaO3)
Dentin	Langasite (La3Ga5SiO14)
DNA	Sodium tungstate (Na2WO3)

3. PIZEO TRANSDUCER :

A piezoelectric plate is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical charge. Piezoelectricity, also called the piezoelectric effect, is the ability of certain materials to generate an AC (alternating current) voltage when subjected to mechanical stress or vibration, or to vibrate when subjected to an AC voltage, or both. The most common piezoelectric material is quartz. Certain ceramics, Rochelle salts, and various other solids also exhibit this effect[4].

When a sound wave strikes one or both of the plates, the plates vibrate[7]. The crystal picks up this vibration, which it translates into a weak AC voltage. Therefore, an AC voltage arises between the two metal plates, with a waveform similar to that of the sound waves. Conversely, if an AC signal is applied to the plates, it causes the crystal to vibrate in sync with the signal voltage[9].

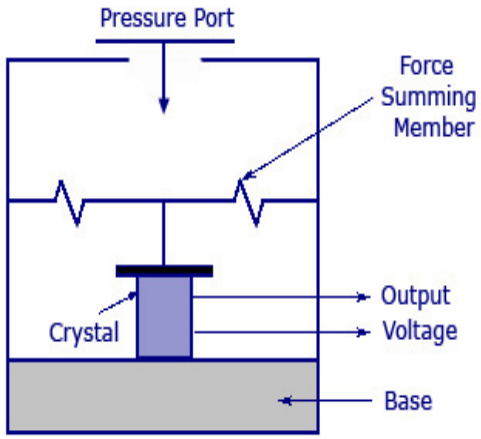

Fig:2. Piezoelectric transducer

A. Super Capacitor

Super capacitors also called ultra capacitors and electric double layer capacitors (EDLC) are capacitors with capacitance values greater than any other capacitor type available today. Capacitance values reaching up to 400 Farads in a single standard case size are available. Super capacitors have the highest capacitive density available today with

densities so high that these capacitors can be used to applications normally reserved for batteries. Super capacitors are not as volumetrically efficient and are more expensive than batteries but they do have other advantages over batteries making the preferred choice in applications requiring a large amount of energy storage to be stored and delivered in bursts repeatedly.

B. Relay:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical

C. Battery:

Battery consists of electrochemical cells to store electricity house in a single unit. In battery stored chemical energy is transformed into electrical energy. Some batteries are used once and some of them are rechargeable. Large batteries also provide stand by operation i.e. mobile, laptops etc.

D. Inverter:

A inverter is an electrical power converter that changes direct current (DC) to alternating current(AC). The input voltage, output voltage, and frequency are dependent on design. Static inverters do not use moving parts in the conversion process. Some applications for inverters include converting high-voltage direct current electric utility line power to AC, and deriving AC from DC power sources such as batteries.

E. Voltage Regulator:

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage induced. The project "POWER GENERATION USING FOOT STEP AND HEAT" is successfully tested and implemented. it provides the affordable energy solution. India is the developing country where energy management is big challenge for huge population. By using this project we can derive both A.C and D.C drive according to force we applied. India is the developing country where energy management is big challenge for huge population. By using this project we can derive both A.C and D.C drive according to force we applied[8]

5. OUT PUT POWER:

1. The output voltage obtained from a single piezoelectric crystal is in milli volt(mV) range, which is different for different crystals. and the voltage is in microwatt(µW) range.
2. In order to achieve higher voltages, the piezoelectric crystals can be arranged in series[1].
3. Used to charge batteries for backup supplies or to power low-power microprocessors.

4. CONCLUSIONS :

The project "POWER GENERATION USING FOOT STEP AND HEAT" is successfully tested and implemented. it provides the affordable energy solution. India is the developing country where energy management is big challenge for huge population. By using this project we can derive both A.C and D.C drive according to force we applied. India is the developing country where energy management is big challenge for huge population. By using this project we can derive both A.C and D.C drive according to force we applied[5].

Piezoelectricity is a revolutionary source for "GREEN ENERGY".

- Flexible piezoelectric materials are attractive for power harvesting applications because of their ability to withstand large amounts of strain.

- Convert the ambient vibration energy surrounding them into electrical energy[4].
- Electrical energy can then be used to power other devices or stored for later use.

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