PIEZOELECTRIC GENERATOR

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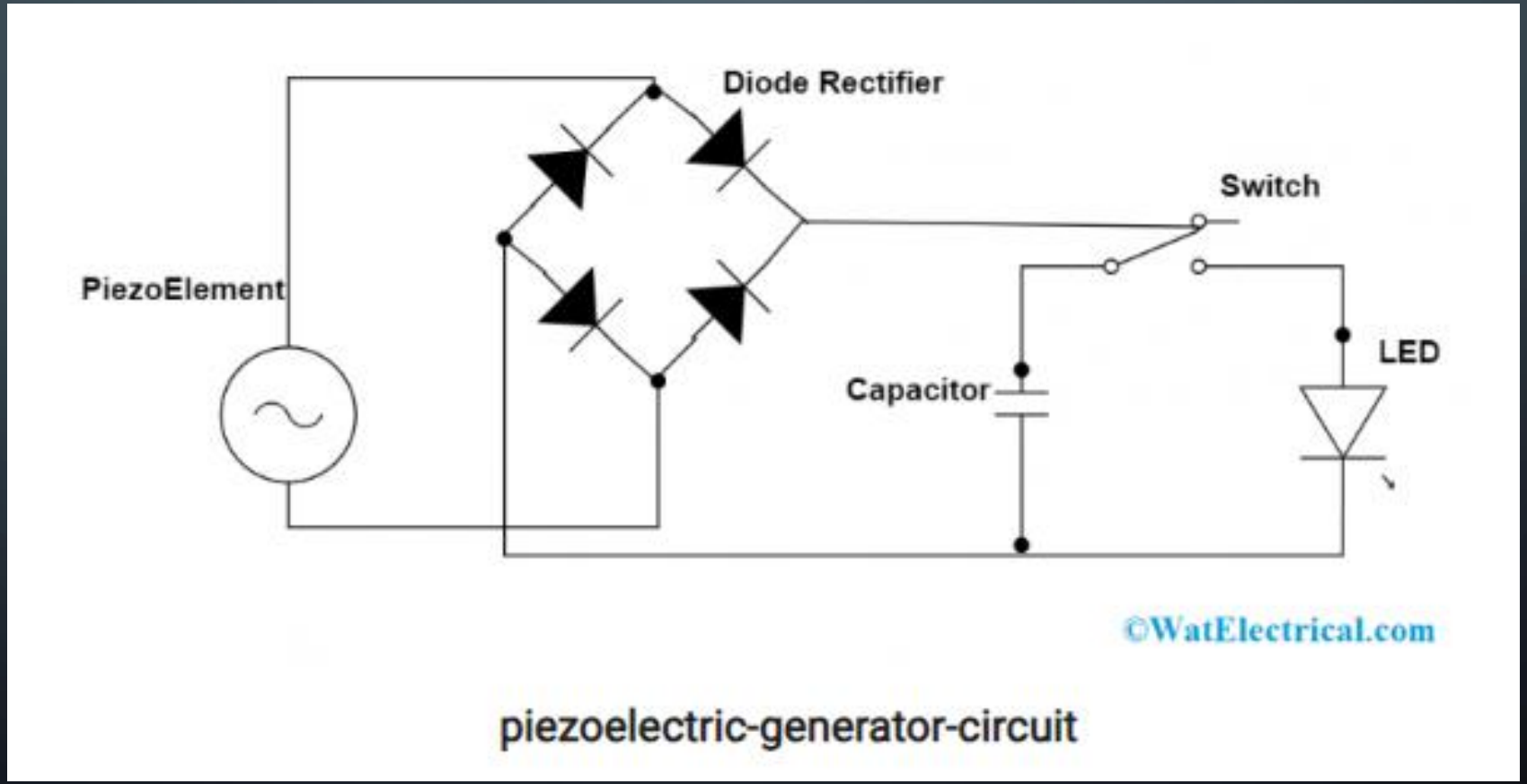
PIEZOELECTRIC GENERATOR

INTRODUCTION:

Electricity has become a lifeline of present day civilization and its demand enormous and is growing steadily. There seems no end to the different ways one can generate pollution-free electricity. At one hand, rising concern about the gap between demand and supply of electricity for masses has highlighted the exploration of alternate sources of energy and its (energy) sustainable use. On the other hand, traffic on road all over the world is increasing day by day and thus, congestion on roads is becoming inevitable with the fancy of masses towards personal transportation systems for their growing mobility. Energy demand and heavy traffic correlation motivate to dream about a device in the road that would harvest the energy from the vehicles driving over it. For this, piezoelectric material embedded beneath a road, the piezo-smart road, can provide the magic of converting pressure exerted by the moving vehicles into electric current.

CIRCUIT DIAGRAM



COMPONENTS

- PIEZO TRANSDUCER/PIEZO ELEMENTS
- DIODES
- ELECTROLYTIC CAPACITOR
- SWITCH
- LED LIGHTS
- ALLIGATOR CLIPS
- CONECTING WIRES

PIEZOELECTRIC MATERIALS

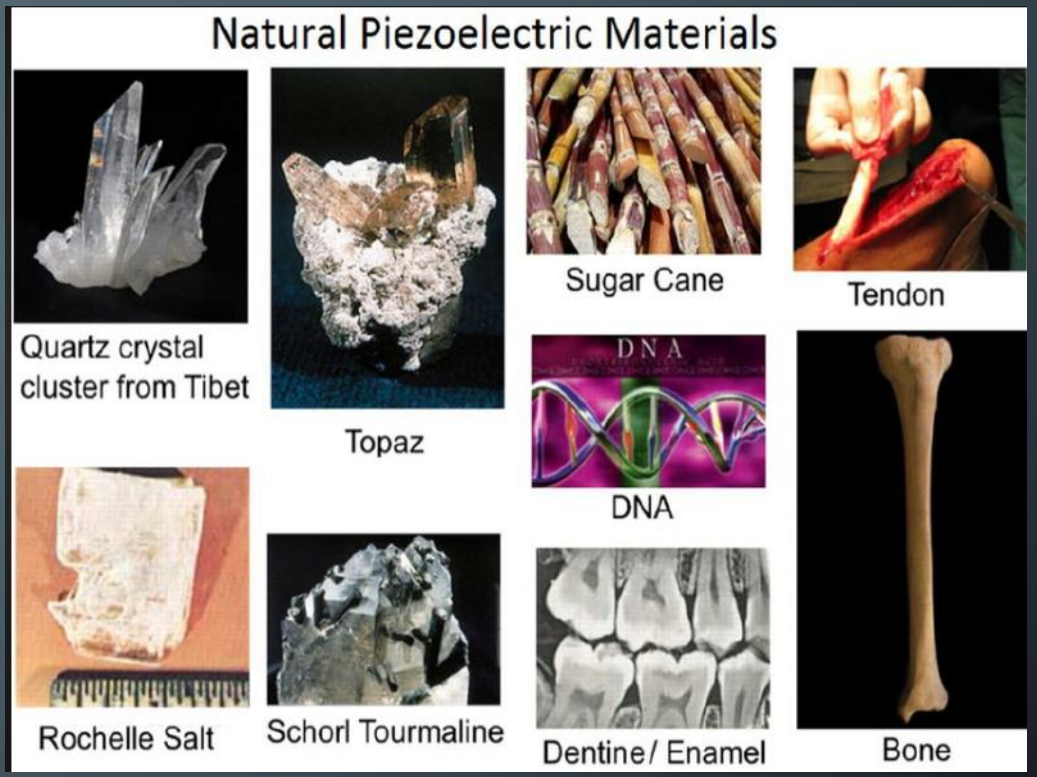
Piezoelectric materials are the materials that have the ability to generate internal electrical charge from applied mechanical stressdiscovery of these materials goes to SIR JACQUES CURIE and PIERRE CURIE. These materials include:

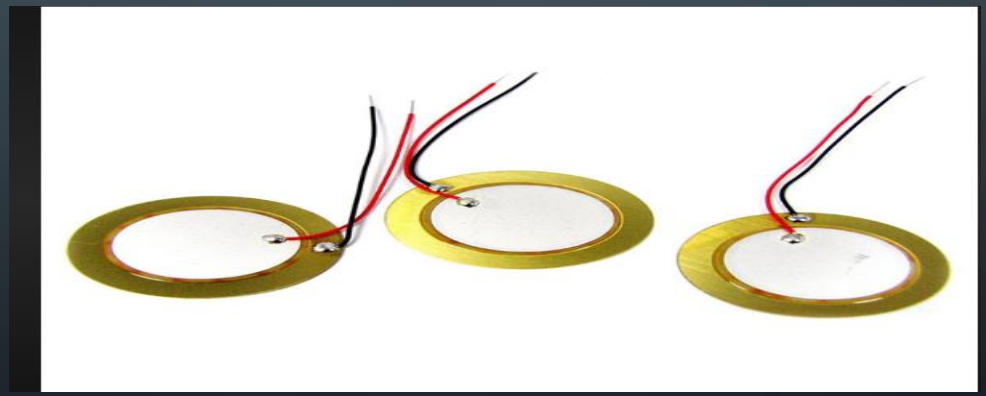
- Lead Zirconate titanate
- Quartz
- Barium titanate
- Aluminium nitride
- Potassium niobate
- Lanthanum gallium silicate

- Piezoelectric materials have unique atomic structures.
- They are ironically bonded and contain positive and negative ions in the form of pairs called as “UNIT CELLS”.
- These materials are available in nature as ANISTROTROPIC DIELECTRIC with NON-CENTROSYMMETRIC CRYSTAL LATTICE , i.e (They don’t have any free electrical charges and the ions lack a centre of symmetry.)

PIEZOELECTRIC MATERIALS

NATURAL	SYNTHETIC
Quartz (most well-known)	Lead zirconate titanate (PZT)
Rochelle Salt	Zinc oxide (ZnO)
Topaz	Barium titanate ($BaTiO_3$)
TB-1	Piezoelectric ceramics Barium titanate
TBK-3	Calcium barium titanate
Sucrose	Gallium orthophosphate ($GaPO_4$)
Tendon	Potassium niobate ($KNbO_3$)
Silk	Lead titanate ($PbTiO_3$)
Enamel	Lithium tantalate ($LiTaO_3$)
Dentin	Langasite ($La_3Ga_5SiO_{14}$)
DNA	Sodium tungstate (Na_2WO_3)





APPLICATIONS

- PEIZOELECTRIC IN TRANSPORTATION
- ACTUATORS IN INDUSTRIAL SECTOR
- SENSORS IN MECDICAL FIELD
- ACTUATORS IN CONSUMER ELECTRONICS
- PEIZOELECTRIC BUZZERS
- MICROPHONES
- MICRO ROBOTICS.

PEIZOELECTRIC IN TRANSPORTATION:

- Peizoelecrtic roads : Power is generated through piezoelectric materials,which can be used for street lights and small scale industries.

ACTUATORS IN INDUSTRIAL SECTOR:

- Diesel fuel injectors
- Fast response solenoids
- Optical adjustment
- Ultrasonic cleaning

SENSORS IN MEDICAL FIELD:

- Ultrasound imaging
- Ultrasonic procedures

ACTUATORS IN CONSUMER ELECTRONICS

- Printers
- A dot max printer
- Inkjet printer
- Speakers
- Buzzers

DEFENCE APPLICATIONS:

- Micro robotics
- Course changing bullets

OTHER APPLICATIONS:

- Implemented in gyms
- Used in poer generating shoes

ADVANTAGES

- Movement of vehicles are mostly constant on busy roads and so constant poer is generated.
- The power generated in this concept is green power and there is no harm on the environment.
- The power generated can be used in street lights and small scale purposes.
- The response is very fast . Even the remote area can be easily electrified.
- Ii very easy to control small displacement with the applied voltage.

DISADVANTAGES:

- It exhibits high hysteresis and creep.
- High electric field may lead to breakdown and failure.
- Maintenance of road is very difficult and constant inspection are to be made.

SWOT ANALYSIS:

STRENGTHS:

- ENVIRONMENTALLY FRIENDLY: It produces electricity without relying on fossilfuels , making them sustainable and and clean energy.
- LOW MAINTAINANCE: These generators has no moving parts,reducing maintainance.
- COMPACT AND SCALABLE : They can be designed in small sizes ,making them suitable for wide range of applications.
- ENERGY HARVESTING CAPABILITIES: They convert mechanical vibrations into electrical energy.

WEAKNESS:

- LIMITED POWER OUTPUT: Piezoelectric generators may produce relatively low power output compared to other energy sources.
- DEPENDENCE ON VIBRATIONS: The efficiency of these generators is completely depending on mechanical vibrations , limiting their use on static environments.
- FREQUENCY AND TUNING REQUIRMENTS: To achieve optimal efficiency ,these generators require tuning to match the specific frequency.

OPPORTUNITIES:

- ENERGY HARVESTING IN IOT DEVICES: The rise of IOT devices presents an opportunity for piezoelectric generators to power low energy sensors and small scale electronics without relying on batteries.
- WEARABLE TECHNOLOGY: Piezoelectric generators can be integrated into wearable devices to harness energy from human motion.
- SMART INFRASTRUCTURE APPLICATIONS: The integration of piezoelectric generators into buildings ,bridges,and roadways can enable energy harvesting from structural vibrations and contribute to self powered smart infrastructure.

THREATS:

- COMPETITION FROM OTHER ENERGY RESOURCES:Peizoelectric generators face competition from other conventional power soures , which may be more established or economically viable for certain applications.
- TECHNOLOGICAL LIMITATIONS:The efficiency and output power may not match the demands of high power applications, limiting their widespread adoption.
- ECONOMIC FACTORS: The cost of manufacturing piezoelectric generators and associated components could be a barrier to their adoption in certain markets.

THANK YOU