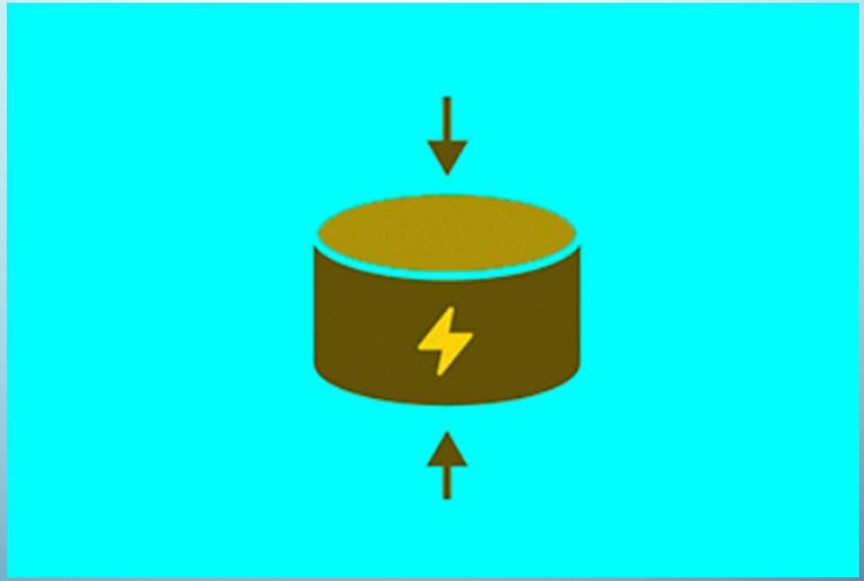
PIEZOELECTRICITY



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WHAT IS PIEZOELECTRICITY?

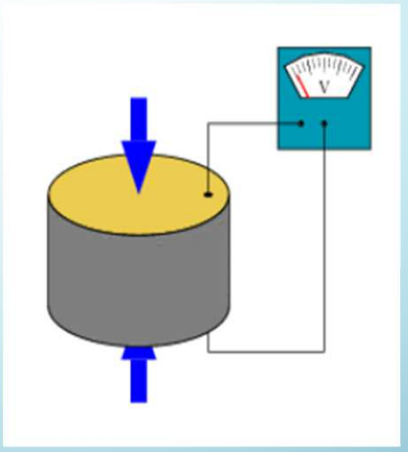
DIRECT EFFECT

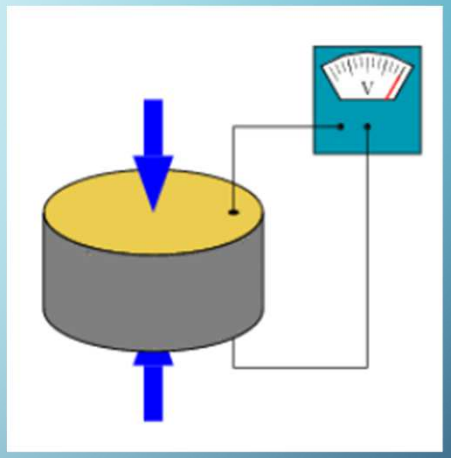
This phenomenon is based on the production of current when the material (piezoelectric) is compressed or stretched.

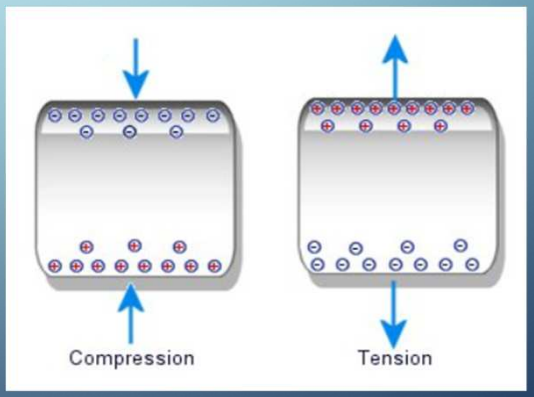
-Compression
-Tension

REVERSIBLE EFFECT

When an electric field is applied to certain faces of a crystalline formation, it experiences mechanical distortions (inverse piezoelectric effect). It is important to note that when we remove the electric field the material will recover its original shape.

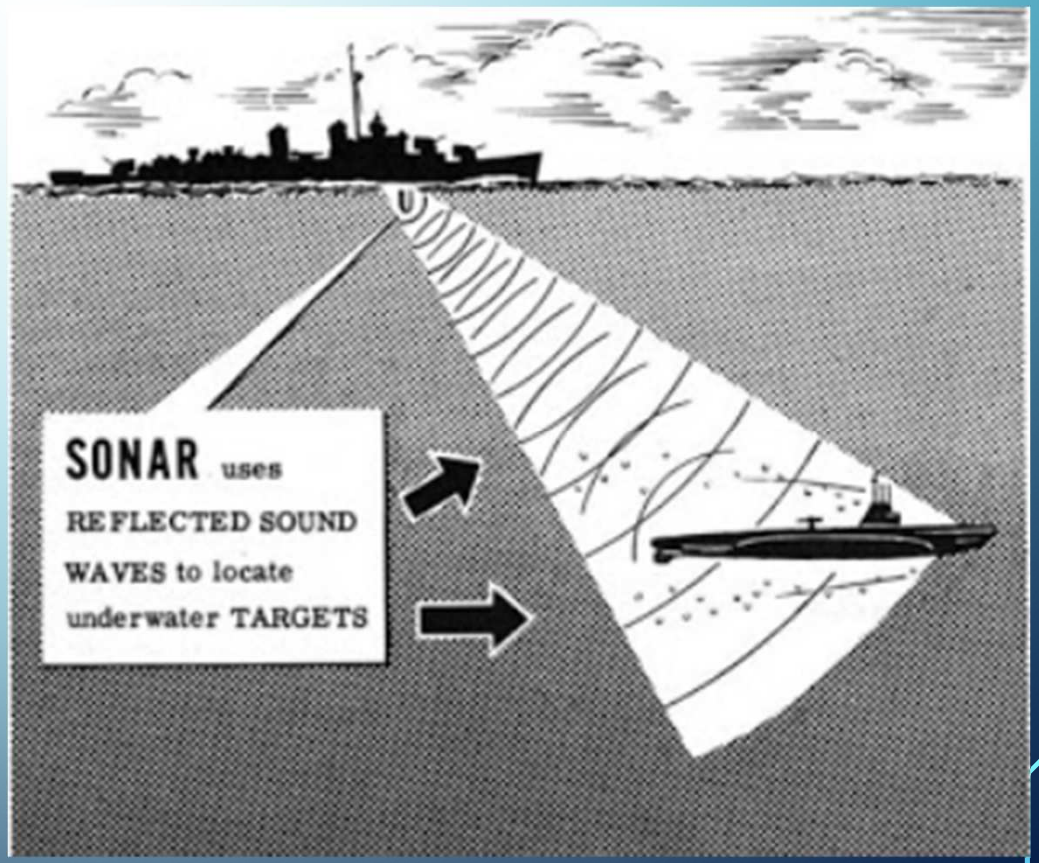






PIEZOELECTRIC MATERIALS EVOLUTION

- The piezoelectric effect was discovered in 1880 by Jacques and Pierre Curie.
- In 1881, Gabriel Lippmann discovered the reversible effect
- After two years of interactive work by the European scientific community, established the bases of the main piezoelectric applications:
- In 1910, Woldemar Voight, a German physicist, published the work that would serve as standard reference
- The first practical application of the piezoelectric effect was carried out by Paul Langevin, a French physicist, in 1917.



Between WWI and WWII :

- microphones
- accelerometers
- signal filters

Although the available materials (mainly quartz) limited the performance capacity of the devices.

During the Second World War:

- United States
- Japan
- Soviet Union

They discovered that some materials ceramics had dielectric constants up to 100 times greater than common crystals:

- PZT
- BaTiO3

They began to adapt the materials to the application to be made and not on the contrary

“Piezoelectric materials are difficult to develop, but easy to reproduce once the process is known.”

Barium Titanate Application Research Committe

Between 1960 and 1980, when in the rest of the world the advances in piezoelectric applications were slow, in Japan they were obtained major advances in research.

Nowadays:

- Booming market
- The number of publications related about piezoelectric has increased since 1990.

PIEZOELECTRIC MATERIALS

Piezoelectric materials are natural or synthetic crystals that lack a center of symmetry (main characteristic).

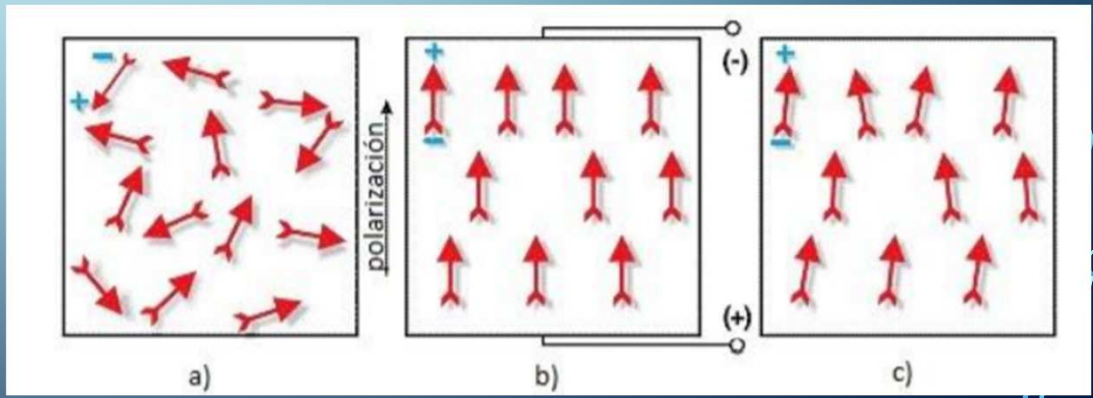
<u>2 GROUPS</u>

1. Natural piezoelectrics

1. Ferroelectrics

- Polycrystalline ceramics
- Monocrystalline Materials
- Piezoelectric Polymers (PVDF)
- Thin films

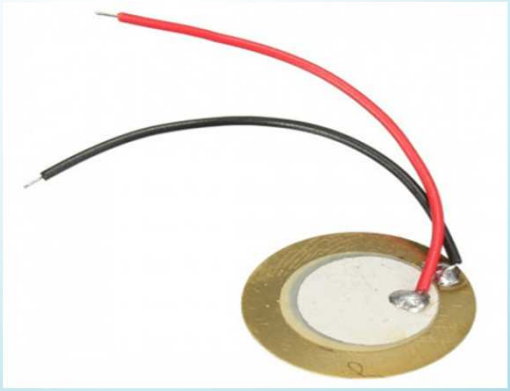
<u>Production process of a piezoelectric ceramic</u>



IMPLEMENTATION OF PIEZOELECTRIC

- Sensors

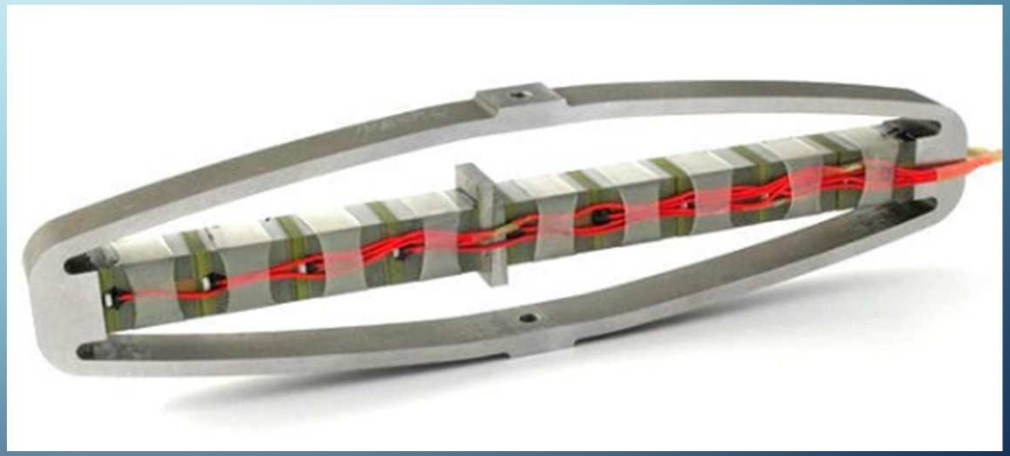
Piezoelectric sensors convert a physical input (acceleration, pressure, etc.) into an electrical signal that serves as an input to a data processing system.



- Actuators

A piezoelectric actuator converts an electrical signal into a precise physical displacement.

Industrial applications, medical applications, aviation, aerospace.

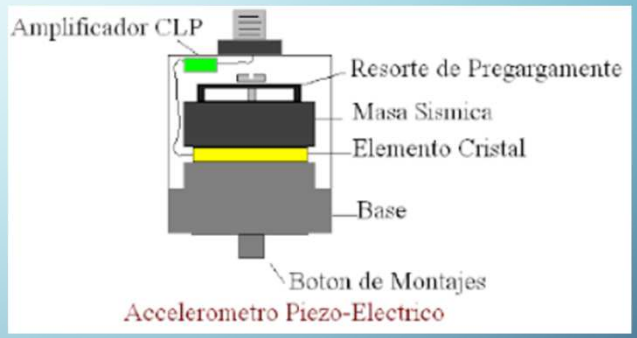


- ## Transducers

A transducer is any device that serves to convert one type of energy into another. Piezoelectric transducers are a type of electroacoustic transducers that convert the electricity produced in piezoelectric ceramics into another type of energy.

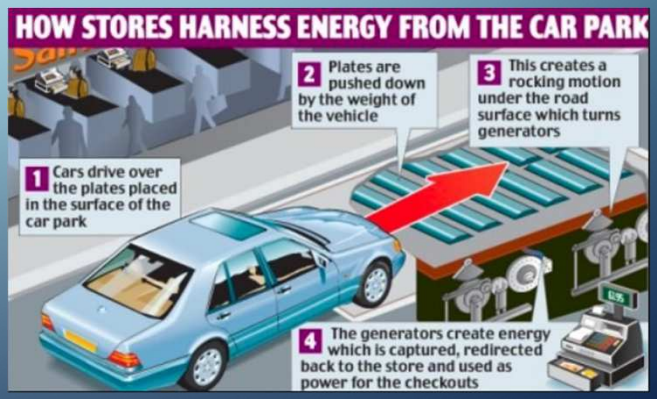
- ## Accelerometers

An accelerometer is a type of sensor that measures the force due to the acceleration of the sensor. The transducer measures the force exerted on the mass due to acceleration.



- ## Generators

A piezoelectric generator is a piezoelectric ceramic that converts mechanical energy into electrical. Unlike a sensor or other type of piezoelectric device capable of converting mechanical energy into electrical, generators seek to convert the maximum amount of energy.



PIEZOELECTRIC PROJECTS

- ## Club4Climate

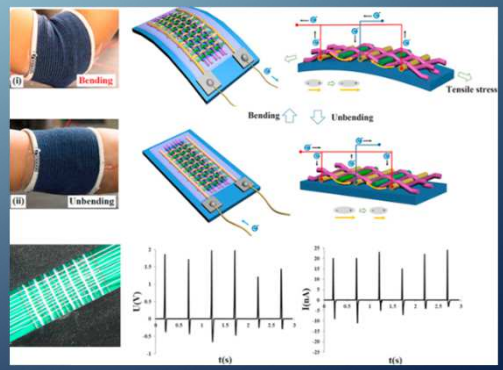
The piezoelectric dance floor uses quartz crystals and ceramics to transform each jump or stroke into electricity. With this action a series of batteries connected to the ground, which in a meeting provide around 60% of the energy to fill the room with light and sound.

- ## Tokyo station

In the busiest stations in Tokyo, special tiles have been installed that have been installed in front of the turnstiles and entrance doors to the subway. Each time a passenger steps on the tile, a small vibration occurs that can be stored as energy.

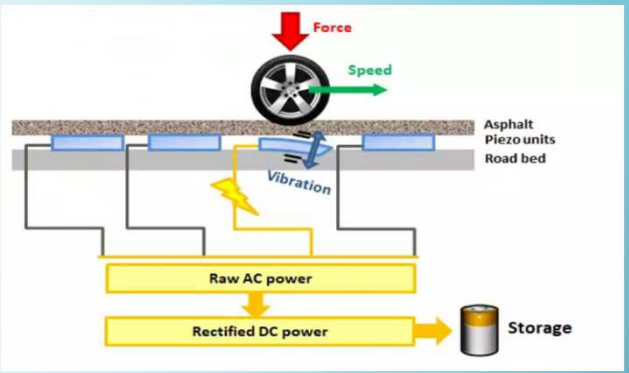
- ## Power Shirt

Power Shirt is the name of a new nanotechnology that, applied to clothing, can keep our personal electronic devices such as cell phones, PDAs, cameras, etc., taking advantage of our movement or physical exercise that is transformed into electricity.



- ## Innowatech

The Israeli company Innovatech placed piezoelectric sensors under the asphalt of a highway so that, with the passage of vehicles, and thanks to the pressure and vibrations that they produced, they would generate energy. Batteries installed on both sides of the road picked up electricity. The results were very encouraging, since during the course of the experiment electricity was produced capable of efficiently illuminating that same road.



- ## Pressure Control

Siemens VDO has introduced its new pressure control system that does not require external power. The elements with piezoelectric crystals are responsible for feeding the sensors and the data transmission module. These quartz crystals are subjected to deformation during the normal running of the car. With the consequent piezoelectric effect that produces the electrical energy necessary for the operation of the equipment.

- ## Piezoelectric Radars

This speed control system consists of sensors on the road, which measure at two different points when they are stepped on to calculate the speed. They are much cheaper than the usual cinemometers and cover all lanes.