A PIEZOELECTRIC SUSTAINABLE FUTURE

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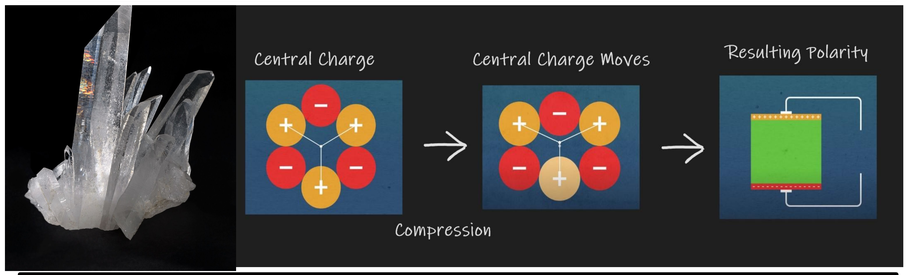
INTRODUCTION

What is Piezoelectricity?

- It is electricity generated by applying a force to a crystalline lattice where some materials are better at creating a voltage then others and the energy generated is directly proportional to the the force. [1]
- How does this work? Well, it involves stressing a polar-bonded crystalline lattice with mechanical energy. This compresses the lattice pushing the central charge away from the center to create an oppositely-charged structure from which current can flow. [1]
- Additionally, the process is reversible where by applying an electric field causes mechanical deformation in the crystal. This is called the Converse Piezoelectric Effect. [1]



HISTORY

Origins:

- Discovered by the Curie brothers in 1880 but the term was named by Hankel in 1881. [2]
- The word Piezoelectricity comes from the Greeks meaning “electricity by pressure.” [2]
- The Converse Piezoelectric Effect was discovered by Gabriel Lippmann in 1881. [2]

Historical Uses:

- Converse effect was used in the first SONAR in WWI. [2]
- Phonographs and Radios. [2]
- A more contemporary example would be a household BBQ lighter.

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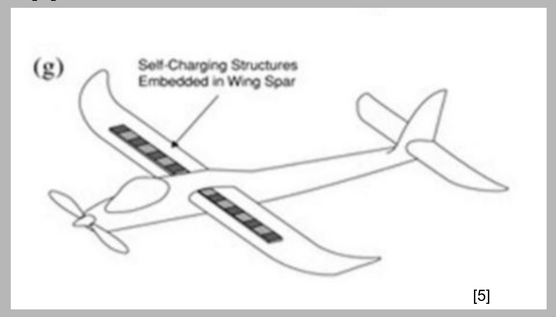
CURRENT INNOVATIONS

Piezoelectric Walkways:

- Utilizes a triangular design creating a continuously articulated surface with no dead zones in order to capture energy from almost every footstep. [3]
- One step produces “a voltage of 6.8 V and power 0.000318 W when given 441 N” force. [3]
- PAVEGEN implemented a Piezoelectric sidewalk in Washington D.C. as part of the “Sustainable D.C. project, and cost $75 -$160 per square foot to install. [4]

Power For Unmanned Aerial Vehicles:

- Structural vibrations in unmanned aerial vehicles (UAVs) can be harvested and converted to electrical energy to power onboard electronic components. [5]



[5]

Power Sources for Low-Power Electronics:

- Small multi-layer piezoelectric generators can provide enough current to power small devices such as wireless sensors.
- Power generated by vibration of lead zirconate titanate (PZT) maxes at “2mW and provides enough energy to charge a 40mAh button cell battery in one hour.” [6]

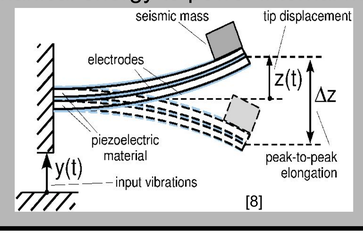
WHAT’S THE POINT?

- We live in a world where resources are finite. Using a technology that turns waste energy into something usable is a no brainer!
- Harvested energy can be applied to power wearable technology and other portable technologies giving us access to electricity no matter where we are
- This technology provides a way to generate electricity for countries with an ever-increasing demand.
- Harvesting wasted mechanical energy is just another method we can use to achieve a future of non-fossil fuel sustainable energy.

A BRIGHT FUTURE

What’s next?

- Creating a self-charging battery with piezoelectric material. [7]
- Use mechanical energy from car vibrations to supplement battery energy as well as store it. [8]
- Use kinetic energy from humans to power wearable technology and small devices.
- Use biomechanical energy to power internal medical devices.



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