

Emerging technology: Piezoelectric energy harvesting

Piezoelectricity: “electricity from vibration or movement”. Piezoelectric materials convert mechanical stress into electricity. Piezoelectrics function due to a change in “dipole moments” by certain crystals when applying a mechanical stress. This also works in reverse whereby piezoelectric materials will vibrate at a certain frequency when subjected to an applied voltage.

These technologies exist in many current applications – particularly in music (guitar pickups are piezoelectric sensors and loudspeakers convert voltage to mechanical movement).

Natural materials such as bone exhibit piezoelectric properties!

Materials scientists are actively investigating ceramics and thin films with piezoelectric properties.

DISPLAY: CERAMIC “ADVANCED CERAMETRICS” ENERGY HARVESTING PIEZO STRIP

Discussion:

What are possible uses of very small engineered piezos?

Engineered piezoelectric films have great potential in energy harvesting applications and for applications of miniaturized systems (Microelectromechanical or “MEMS” devices and microfluidics). Other uses are in “embedded systems” where sensors are powered by ambient energy.

Other possibilities:

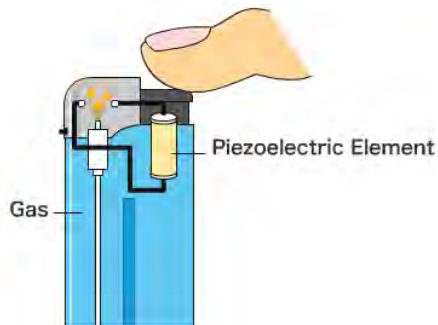
- powering medical devices
- harvesting the wasted energy in mechanical vibrations in industry and automobiles.
- Self-powered sporting goods

RESOURCES

Another common piezo is found in lighters. See display!

Extracting a piezoelectric crystal from a bbq lighter:

<http://rimstar.org/materials/piezo/ignitor1.htm>



Pierre and Jacques Curie first discovered piezoelectricity in the 1880's!

<http://www.aip.org/history/curie/pierre.htm>

The piezoelectric vibration/oscillation of quartz crystals when subjected to an electric current is widely used in timepieces:

<http://electronics.howstuffworks.com/gadgets/clocks-watches/quartz-watch.htm>

Cool YouTube tutorial “How to make a Piezo Contact Microphone”

<http://www.youtube.com/watch?v=4hZPt-w6UPE>

Arduino project which uses a piezo to flash LEDs to music:

<http://negativeacknowledge.com/2008/06/final-lightbar-controller/>

piezo element from sparkfun

<http://www.sparkfun.com/products/10293>

Piezo film from inventables

<https://www.inventables.com/technologies/piezo-film>

RELATED STANDARDS

Investigation and experimentation

Grade 4 physical sciences - Electricity and magnetism (esp. 1f)

Grade 9-12 physics – Electric and Magnetic phenomena (5)