

Trade secrets

Piezoelectric crystals

Gas lighters, mosquito bite relief and police sirens – Jonathan Hare explores piezo chemistry in action!

Did you know?



Bones show piezoelectric properties. The effect is thought to act as a biological force sensor.

When a piezoelectric crystal is bent or stressed the distribution of charge inside the crystal changes. This results in the creation of positive and negative charges on opposite faces of the crystal, generating a voltage. If we connect wires to the faces of the crystal we can make use of this voltage. Examples of piezoelectric materials include quartz, Rochelle salts (potassium sodium tartrate), many plastics, table sugar and even bone.

When you 'click' the button on a gas lighter, an internal piezoelectric crystal is stressed, producing a high voltage pulse (around 100–200 volts). The ends of the two wires from the crystal are arranged so they almost touch and the spark created by the voltage pulse lights the gas.

Mosquito bites

There are all sorts of other day-to-day uses for piezoelectricity. For example, while on holiday in Greece this year I used a small piezo device to treat mosquito bites and stings. The small electrical shock created by the crystal is applied directly to the skin around the bite. This inactivates the histamine response that causes the itch, stopping the urge to scratch and reducing the swelling.

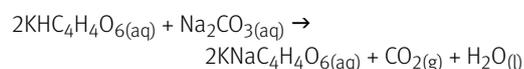
The piezoelectric effect is reversible – if you apply an alternating voltage to a crystal it will physically oscillate. Piezoelectric transducers such as these can produce very loud sounds and are used in smoke detectors, alarms and police sirens.

Piezoelectric crystals were used in early electronic

record players. The crystal was attached to the needle and as the record rotated, the groove vibrated the crystal, creating a signal that could be amplified.

Try it yourself!

You can make Rochelle salt crystals yourself by reacting warm aqueous solutions of potassium hydrogen tartrate (cream of tartar) and sodium carbonate (washing soda – both these chemicals are available from a supermarket). Mix the solutions together and over time crystals will drop out of the solution as it cools. These can be used directly, or for growing larger crystals from a saturated solution.



You can test the micro-physics of your crystal by wiring it to the input of a set of powered computer speakers. When you tap the crystal you can hear the 'tap' coming out of the speakers.

Listening to dolphins

In the BBC TV series *Rough Science*, presenter Mike Bullivant showed how to make some fantastic crystals using this method. I fitted one of his smaller crystals to a tin can (which acted as a diaphragm). With suitable wiring and waterproofing I used it to make a very basic hydrophone (an underwater microphone) to listen to the fish and dolphins!

You can make a simple and cheap piezoelectric device that creates enough energy to flash an LED when the crystal is flicked. Find out how at <http://bit.ly/14jnP8A>

Find out more

Learn how piezoelectric materials can be used to improve the efficiency of solar cells with this article from *Chemistry World*:
<http://rsc.li/yuVBff>

Topaz crystals exhibit piezoelectric properties

