Will you be your own battery

Remember when you're big sister would shuffle her feet across the carpet to give you a shock behind your ear? Well, the effect that produces the static electric charge could soon be used to help protect the environment and improve our health, too.

The effect, called the triboelectric (pronounced tribe-oh-electric) effect, results from a charge created by friction when different materials rub together. The effect is most potent when one material likes to give up an electron, and the other material likes to take an electron. For instance, your skin likes to give off electrons, and polyester likes to take electrons. When your skin rubs against polyester, ZAP! Explains a lot, right?

In 2012, Dr. Zhong Lin Wang of the Georgia Institute of Technology first built a triboelectric nanogenerator, or TENG, using these small bursts of mechanical power to perform work. And his idea has really taken off, creating whole new industries and offering new ways to combat climate change.

The adverse effects of climate change invade the news every day. Finding ways to create eco-friendly energy demands our immediate attention. Imagine a world where remote control devices don't use batteries, medical implants power themselves, and the fabric you wear charges your smartphone. With the development of TENG, commercially available products that use our body movement to produce electricity are just around the corner.

Portable Electronics Without Batteries

You reach for your TV remote and push the button. Nothing happens. Dead batteries. After replacing the old batteries with fresh ones, the dead cells get

dumped in a pile, waiting for you to take them to a special drop off location for recycling. Or worse, those batteries wind up in the landfill, leaching toxins back into the environment.

What if you could get a remote that never needs to have its batteries replaced? One that just always works? Sounds amazing! And, think about all the batteries that will never need to go into remotes, lose their charge, and then need special care to recycle.

A team from Clemson Nanomaterials Institute in South Carolina want to do just that. A 3D printed graphene circuit that emits a triboelectric charge paired with a Teflon sheet allows the team to control a screen that switches between being opaque then mirrored when pressed. While the technology is still in the R&D stage, it shows the potential of a future without toxic batteries.

Self-Powered Medical Implants

If you ever needed to get a pacemaker or some other medical implant, you might worry that your device will run out of power when the battery dies. A US-Chinese team lead by Dr. Wang wants to change all that. In 2016, this team was the first to implant a triboelectric device into an adult pig successfully.

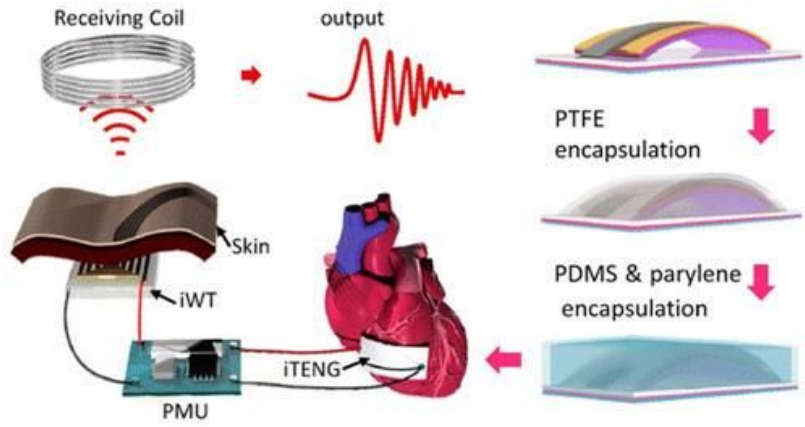
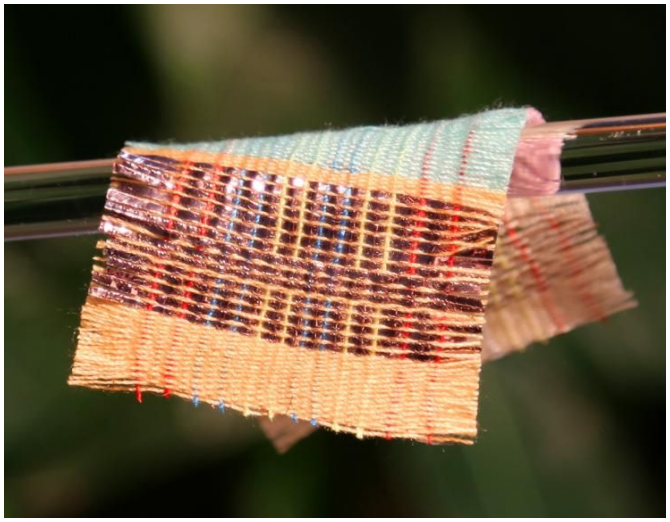


Diagram describing a triboelectric nanogenerator implanted in a pig.

This breakthrough technology paves the way for implantable devices that don't require batteries. Dr. Wang remarked that this work is, "…the first demonstration of a self-powered, implantable wireless system for real-time in vivo monitoring through comprehensive experiments in large-animal scale."

Fabric That Creates Energy

Whenever you move, you create energy. Even typing creates a small amount of energy that can be harnessed and used to power devices like smartphones.


Energy producing textile

For the last few years, researchers have worked on developing fabrics that cannot only harness the energy of your movement but also capture the solar energy from the sun as you walk around in your normal daily routine.

The team makes the textiles by weaving solar cells constructed from lightweight polymer fibers with fiber-based triboelectric nanogenerators. The nanogenerators unite the triboelectric effect and electrostatic induction to generate a small amount of power from mechanical motion.

DC-TENG Paves the Way Forward

While research into commercializing TENG devices has been underway for over a decade, development has stalled due to the unpredictable stream of current these nanogenerators produce. A typical TENG produces a pulsed, AC output that isn't suitable for most applications. These systems rely on a rectifier and an energy storage unit to generate a stable DC output.

In April of 2019, however, a US-Chinese partnership produced a next-generation TENG capable of producing a constant DC output. With the ability for DC-TENG devices to power themselves directly, it could soon be possible to shrink self-powered systems supporting IoTs devices.

The Future of TENG

The world is getting smaller. Some people alive today may remember a time in the past when it took months to travel to the other side of the Earth. Now it only takes about 12 hours. And as the world shrinks, so do the interconnected devices

we use to exist in this new reality. And all these things demand electricity to operate.

The internet of things and artificial intelligence push us toward a world where everyone and everything links together in a vast web of connections. And not just in an abstract metaphysical sense but in a tangible, physical sense. In this new paradigm, technology shrinks and becomes mobile, requiring new distributed power supplies.

Solar, thermal, hydroelectric, and wind energy all have their place. But for many emerging technologies, self-generated power from a TENG will be the best option. Triboelectricity is a common effect that works everywhere, and a wide variety of materials can produce it. Just like wired communication gave way to wireless, so too will externally powered devices give way to self-powered ones.