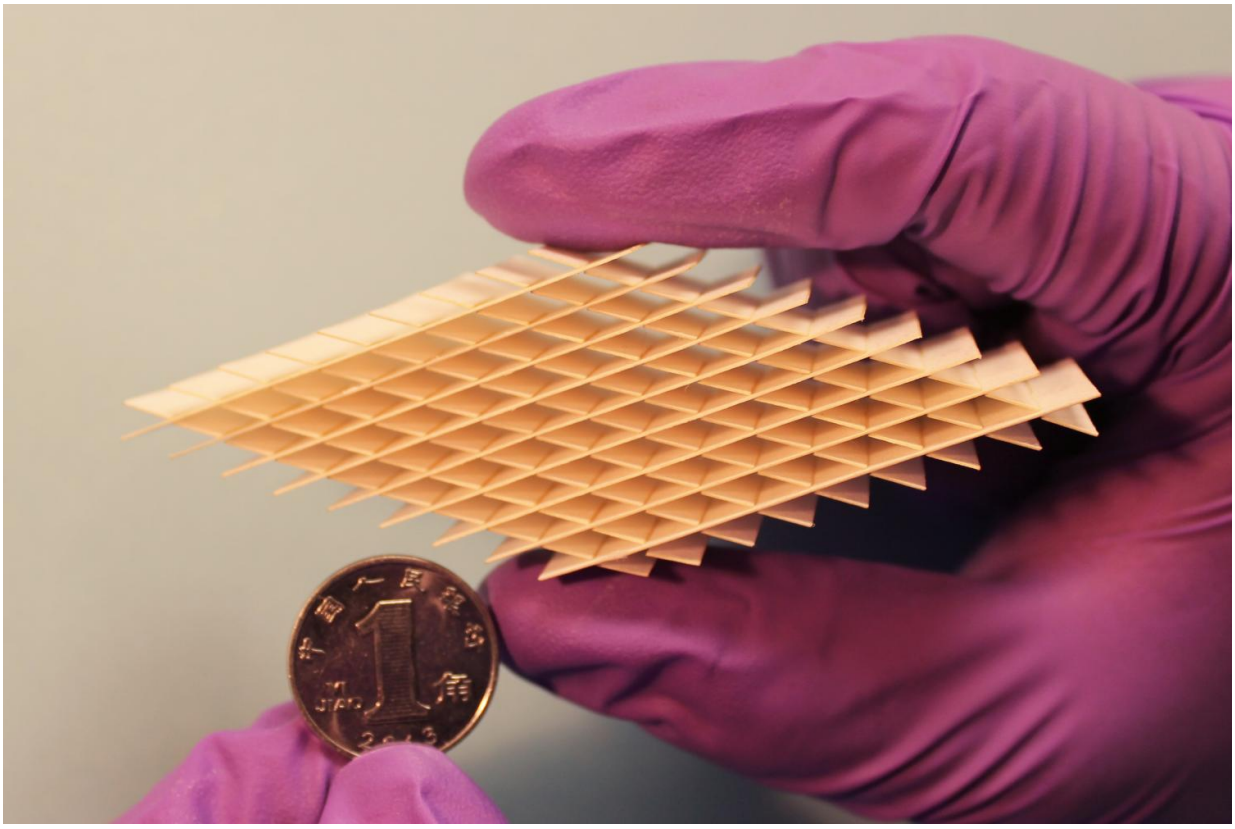
Art of paper-cutting inspires self-charging paper device

April 12 2017



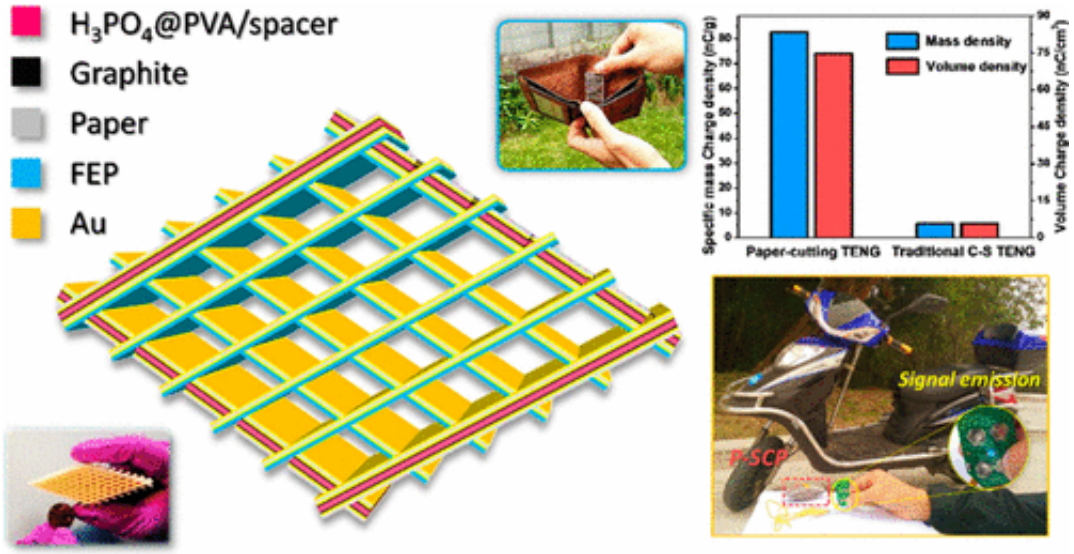
Researchers have developed a paper-based device inspired by the Chinese and Japanese arts of paper-cutting that can harvest and store energy from body movements. Credit: American Chemical Society

Despite the many advances in portable electronic devices, one thing

remains constant: the need to plug them into a wall socket to recharge. Now researchers, reporting in the journal *ACS Nano*, have developed a light-weight, paper-based device inspired by the Chinese and Japanese arts of paper-cutting that can harvest and store energy from body movements.

Portable electronic devices, such as watches, hearing aids and heart monitors, often require only a little energy. They usually get that power from conventional rechargeable batteries. But Zhong Lin Wang, Chenguo Hu and colleagues wanted to see if they could untether our small energy needs from the wall socket by harvesting energy from a user's body movements. Wang and others have been working on this approach in recent years, creating triboelectric nanogenerators (TENGs) that can harness the mechanical energy all around us, such as that created by our footsteps, and then use it to power portable electronics. But most TENG devices take several hours to charge small electronics, such as a sensor, and they're made of acrylic, which is heavy.

So the researchers turned to an ultra-light, rhombic paper-cut design a few inches long and covered it with different materials to turn it into a power unit. The four outer sides, made of gold- and graphite-coated sand paper, comprised the device's energy-storing supercapacitor element. The inner surfaces, made of paper and coated in gold and a fluorinated ethylene propylene film, comprised the TENG energy harvester. Pressing and releasing it over just a few minutes charged the device to 1 volt, which was enough to power a remote control, temperature sensor or a watch.



Credit: American Chemical Society

More information: Ultralight Cut-Paper-Based Self-Charging Power Unit for Self-Powered Portable Electronic and Medical Systems, *ACS Nano*, Article ASAP, pubs.acs.org/doi/abs/10.1021/acsnano.7b00866

Abstract

The development of lightweight, superportable, and sustainable power sources has become an urgent need for most modern personal electronics. Here, we report a cut-paper-based self-charging power unit (PC-SCPU) that is capable of simultaneously harvesting and storing energy from body movement by combining a paper-based triboelectric nanogenerator (TENG) and a supercapacitor (SC), respectively. Utilizing the paper as the substrate with an assembled cut-paper architecture, an ultralight rhombic-shaped TENG is achieved with highly specific mass/volume charge output (82 nC g–1/75 nC cm–3) compared with the traditional acrylic-based TENG (5.7 nC g–1/5.8 nC cm–3), which can effectively charge the SC (~1 mF) to ~1 V in minutes. This wallet-

contained PC-SCPU is then demonstrated as a sustainable power source for driving wearable and portable electronic devices such as a wireless remote control, electric watch, or temperature sensor. This study presents a potential paper-based portable SCPU for practical and medical applications.

Provided by American Chemical Society