Cellulose nanogenerators could one day power implanted biomedical devices

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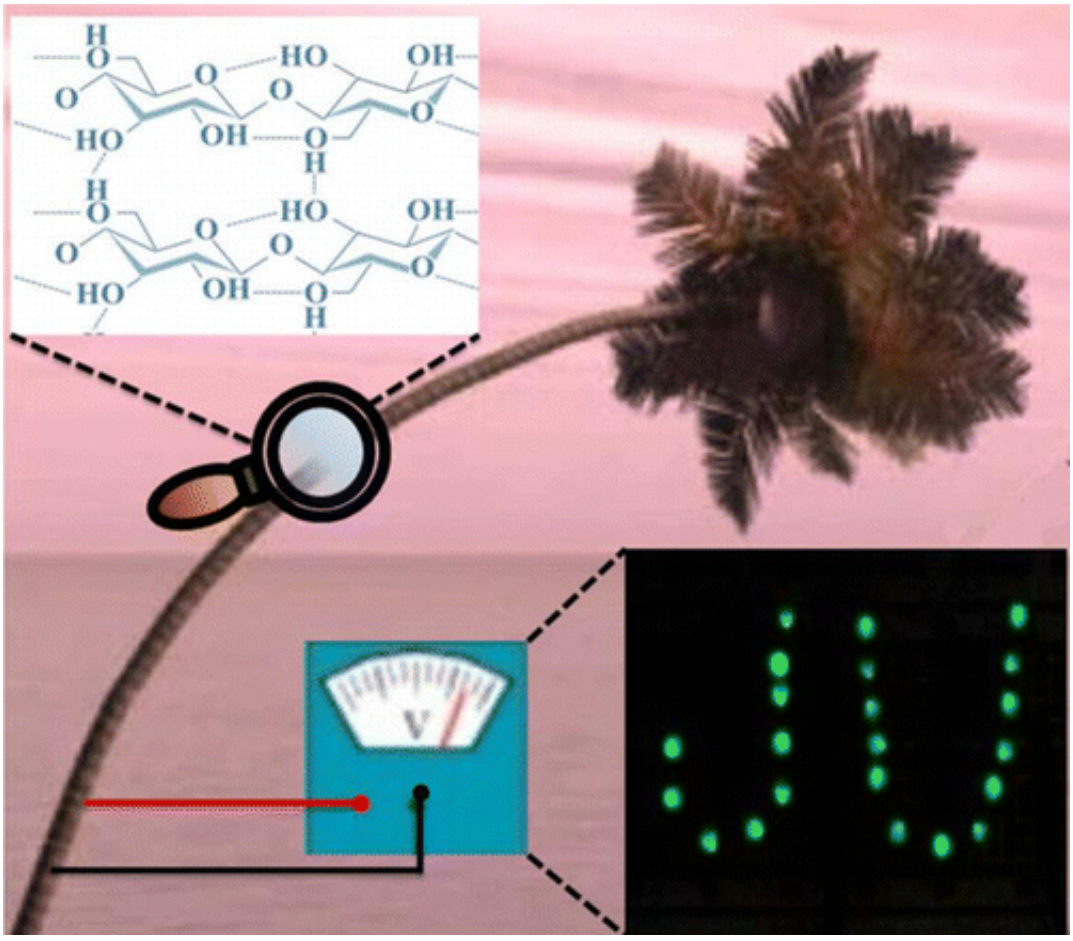

Implantable electronics that can deliver drugs, monitor vital signs and perform other health-related roles are on the horizon. But finding a way

to power them remains a challenge. Now scientists have built a flexible nanogenerator out of cellulose, an abundant natural material, that could potentially harvest energy from the body—its heartbeats, blood flow and other almost imperceptible but constant movements. Their report appears in the journal *ACS Applied Materials & Interfaces*.

Efforts to convert the energy of motion—from footsteps, ocean waves, wind and other movement sources—are well underway. Many of these developing technologies are designed with the goal of powering everyday gadgets and even buildings. As such, they don't need to bend and are often made with stiff materials. But to power biomedical devices inside the body, a flexible generator could provide more versatility. So Md. Mehebub Alam and Dipankar Mandal at Jadavpur University in India set out to design one.

The researchers turned to cellulose, the most abundant biopolymer on earth, and mixed it in a simple process with a kind of silicone called polydimethylsiloxane—the stuff of breast implants—and carbon nanotubes. Repeated pressing on the resulting nanogenerator lit up about two dozen LEDs instantly. It also charged capacitors that powered a portable LCD, a calculator and a wrist watch. And because cellulose is non-toxic, the researchers say the device could potentially be implanted in the body and harvest its internal stretches, vibrations and other movements.

More information: Md. Mehebub Alam et al. Native Cellulose Microfiber-Based Hybrid Piezoelectric Generator for Mechanical Energy Harvesting Utility, *ACS Applied Materials & Interfaces* (2016). DOI: 10.1021/acsami.5b08168

Abstract
A flexible hybrid piezoelectric generator (HPG) based on native cellulose microfiber (NCMF) and polydimethylsiloxane (PDMS) with

multi wall carbon nanotubes (MWCNTs) as conducting filler is presented where the further chemical treatment of the cellulose and traditional electrical poling steps for piezoelectric voltage generation is avoided. It delivers a high electrical throughput that is an open circuit voltage of ~30 V and power density ~9.0 μW/cm3 under repeated hand punching. We demonstrate to power up various portable electronic units by HPG. Because cellulose is a biocompatible material, suggesting that HPG may have greater potential in biomedical applications such as implantable power source in human body.

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