Research from Samsung explores the possibilities of using everyday movement to support motion-powered TENG devices

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Triboelectric nanogenerators (TENGs) are small devices that convert movement into electricity, and might just be what bring us into an era of energy-harvesting clothes and implants. But could TENGs, even theoretically, give us wearable electronics powered solely by the wearer's day-to-day body motion?

The short answer is yes. New research from Samsung Advanced Institute of Technology (SAIT) in South Korea, published this week in *APL Materials*, from AIP Publishing, demonstrates the ability of mechanical energy produced by typical body motions to power a watch or smartphone. Moreover, the research characterizes effects associated with different forms of similar motions on the maximum producible energy they can produce in a TENG.

"We studied the possibility of charging commercialized portable and wearable devices by utilizing the mechanical energy generated by human motion," said Hyeon-Jin Shin, research master at SAIT and one of the authors of the study. "We confirmed that if the mechanical energy is entirely converted into electrical energy, the energy generated by the daily motion of an arm can sufficiently cover the energy consumption of a smart watch and even the stand-by energy consumption of a smart phone."

As interest in TENGs grow, particularly for wearable applications, Shin

and collaborators wanted to address the real-world feasibility of the technology in detail and understand how to optimize the energy conversion.

"Over the past several years, many researchers have demonstrated a potential for energy harvesting using triboelectricity, and TENG's expectations as an energy source for wearable or portable devices have increased," Shin said. "It is important to confirm that the mechanical energy from human motion can cover the energy consumption of the devices to utilize a TENG for small devices."

The research team compared the achievable TENG energy produced in one minute by typical body movements, such as typing or arm swinging, to that consumed in the same time by a range of commercial electronics and wearables. Although even the most vigorous blogging would not yield enough energy to support an active tablet device, the theory showed the semi-passive activities could power smaller phones and smart watches by TENG power alone.

With close investigations of the mechanism that produces electricity in the device, they also discovered that its elasticity, not normally factored into calculating a TENG's maximum possible energy, can offer a boost to the value.

"To fully utilize the mechanical energy from human motion for the TENG, it is very important to increase the maximum possible energy of a TENG based on understanding the factors related to the motion in an aspect of the velocity (kinetic energy) and elasticity (impulse)," Shin said.

With this new insight, Shin and fellow Samsung researchers are poised to keep refining the practical realizations of the technology and use their findings to push the boundaries of what TENG devices can power—and

for how long.

"The optimization of output energy of a TENG in actual use remains a task for future work because a real system has many limitations such as impedance matching, frequency control, and the stability of the structure," Shin said. "Nevertheless, the results of this study give insight into the design of a TENG to obtain a large amount of energy in a limited space."

More information: Kyung-Eun Byun et al, Potential role of motion for enhancing maximum output energy of triboelectric nanogenerator, *APL Materials* (2017). DOI: 10.1063/1.4979955

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