Easy steps to CCCCCHARGE UP

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The research team includes Dr Walid Daoud (right) and PhD student Yang Xiya.
研究團隊包括Walid Daoud博士（右）和博士研究生楊希婭。

Our electronic devices might never run out of battery in the future as long as we keep moving.

Energy spent exercising or even typing at your PC will be converted to electrical energy for powering-up your cell phone, tablet, or other smart electronics thanks to a wearable energy-harvesting device developed by the School of Energy and Environment (SEE).

With this novel device, the energy collected from your daily activities is expected to contribute 5 to 25% of the energy required to run a portable electronic gadget.

The research team, led by Dr Walid Daoud, Associate Professor in SEE, combines two energy conversion concepts, namely piezoelectric and triboelectric effects, to create a hybrid system containing zinc oxide nanorods that maximise the electrification area.

When mechanically compressed, the piezoelectric generator produces polarisation charges, and the triboelectric generator produces triboelectric and electrostatic charges. The flow of these charges passes through an external circuit and forms an electric current that can be stored in the form of electrical energy.

Much of the previous research in the field has focused on the materials and structures for the energy harvesting system with the aim of boosting

energy output and conversion efficiency. Working from a different approach, Dr Daoud's team has unraveled the energy-conversion mechanisms of the individual generators and the combined effects.

"We conducted this pioneering study to better understand the transduction mechanisms. These findings provide a foundation of knowledge to further enhance the conversion efficiency and energy output of hybrid generators. We found that the energy output can be increased by 50 to 60% owing to the zinc oxide nanorods," said Dr Daoud.

Dr Daoud's team is exploring the vast range of possibilities revealed by these crucial findings. For instance, a device could be fabricated using textiles that are also used for your clothing. It could be installed in the sole of your shoe, which could be one of the most efficient settings for harvesting energy pulses produced by movement. The energy generated could be transmitted wirelessly to charge a portable device.

The SEE research has recently been published in the journal *Advanced Functional Materials* and has already drawn interest from potential industry partners. A leading smart electronics company is studying how to apply the technology to smart watches.

"By virtue of its simple design and the range of materials it can be used with, the device is highly practical and the manufacturing cost is expected to be low," added Dr Daoud.

No doubt the ultimate goal is to support 100% of battery life. If so, mobile device chargers and cables might be consigned to history, making life more hassle-free.

簡易充電

到了未來，只要不停移動，我們的手提電子產品或許就永遠不會沒電了。

城大能源及環境學院研製出可隨身攜帶的能量收集器，能把做運動時、甚至在電腦前打字所消耗的能量轉化為電能，為手機、平板電腦或其他智能電子產品充電。

這個新穎裝置能夠收集我們日常活動的能量並轉為電能，預計可為小型可攜式電子產品充電5%至25%。

能源及環境學院副教授Walid Daoud博士領導的研究團隊，結合「壓電效應」和「摩擦電效應」兩項能量轉換原理，研製出一個混合系統，內設納米棒狀氧化鋅，可將產生電量的有效面積擴至最大。

當系統受到擠壓，壓電發電器會產生兩極電荷，而摩擦電發電器則會產生摩擦電荷和靜電電荷。電荷流經外置的電路形成電流，可以電能形式儲起來。

過往不少同類型的研究均着重提高發電量和能源轉換效率，集中研究收集能量系統的材料和結構。Daoud博士的團隊則從嶄新的角度出發，成功解構兩個發電效應的能量轉換運作原理及互相結合的效應。

Daoud博士說：「這項先進研究令我們更清楚了解能量轉換的運作原理。研究成果奠下重要的知識基礎，可提升混合系統發電器的能量轉換效率及發電量。我們亦發現氧化鋅納米棒可使產電量上升五至六成。」

The energy harvesting device charges mobile electronics by converting mechanical into electrical energy.
城大研製的能量收集裝置將動能轉為電能，為手提電子產品充電。

研究成果的應用範圍廣泛，Daoud博士的團隊正探討各種發展潛力，例如以紡織物製作收集器，使之融入成為衣物的一部分；另一個設想是置於鞋墊內，收集步行時產生的能量並轉為電能，再以無線傳輸為手提電子產品充電。這可能是一個最有效的轉換模式。

能源及環境學院的這項研究已在期刊《Advanced Functional Materials》上發表，並引起業界興趣。一家著名智能電子產品公司正研究如何將有關技術應用於智能手錶。

Daoud博士補充：「我們發明的裝置設計簡單，可用多種材料製作，因此非常實用，預計生產成本也很低。」

研究的終極目標，當然是希望手提電子產品可以完全用其充電。屆時，我們不再需要手提充電器、充電線，生活將更輕鬆方便。