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TRIBOELECTRIC ENERGY HARVESTING using self-poled Nylon-11 nanowires

Dr Sohini Kar-Narayan and her team in the Department of Materials Science & Metallurgy at the University of Cambridge, have developed a triboelectric generator using self-poled Nylon-11 nanowires for harvesting energy from mechanical vibrations. The triboelectric generator provides more efficient energy harvesting than other energy harvesting systems, while matching the power output required by many sensors and devices for wireless sensor networks and wearable electronics. The team is now keen to collaborate with partners to develop applications for this technology.

Key Benefits

- A triboelectric generator that can harvest enough energy from ambient mechanical vibrations to power low-power electronic devices
- Replacement for batteries in applications such as wireless networks and wearable electronics
- Power output of around 1W/m^2 - a ten-fold increase compared to standard triboelectric generators
- Harvests energy from a wide range of vibrational frequencies (0-10Hz or more)

Dr Sohini Kar-Narayan is a Lecturer in the Department of Materials Science & Metallurgy. She has expertise in the materials science of devices, and her research focuses on composite materials for energy harvesting.

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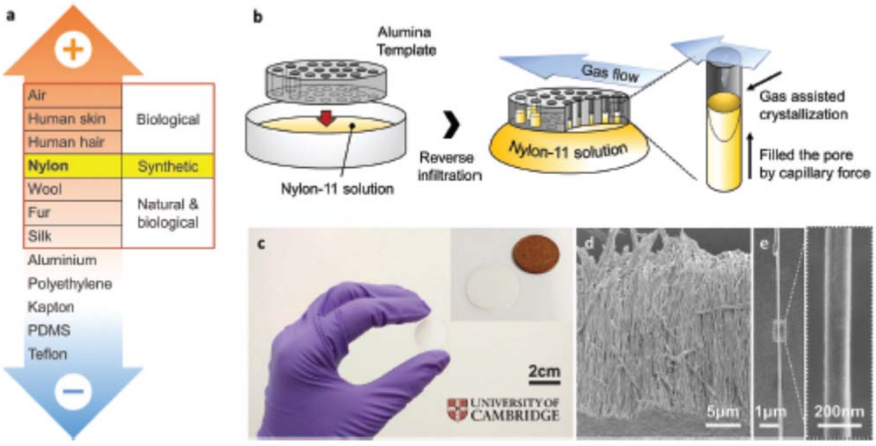

Figure 1 (a) Triboelectric series of common materials; (b) schematic of the nanowire fabrication process; (c) photos of a nanowire-filled template; (d) & (e) SEM images of template-freed nanowires, and a single strand of Nylon-11 nanowire respectively.

Background

The triboelectric effect describes the static electric charge created when two dissimilar materials come into contact. The amount of charge transferred is increased by 2 factors: the area of material in contact, and the opposing materials being on the extreme opposite ends of the triboelectric series (Figure 1a).

Triboelectric generators use this effect to harvest energy from ambient mechanical vibrations. Typically such generators use Teflon (a strongly tribo-negative material) paired with aluminium (which is only mildly tribo-positive), since the vast majority of materials with tribo-positive behaviour are natural biological materials that are difficult to use in practical devices..

Technology

We have developed a strongly tribo-positive material that significantly enhances the performance of tribo-generators. We use a simple, scalable, solution-processing method to produce self-poled Nylon-11 nanowires within a template of a second material (which can be rigid or flexible) (Figure 1b). The nanowires have strong tribo-positive performance, are stable up to 150°C, and are protected from the environment by the surrounding template material. Tests on a triboelectric generator formed from self-poled Nylon-11 nanowires and a Teflon counter-electrode show a ten-fold increase in output power density compared to an aluminium based generator, when subjected to identical mechanical excitations (Figure 2).

Applications

Provides an improved energy harvesting solution for the rapidly growing demand for autonomous, wireless sensor networks and wearable electronic devices.

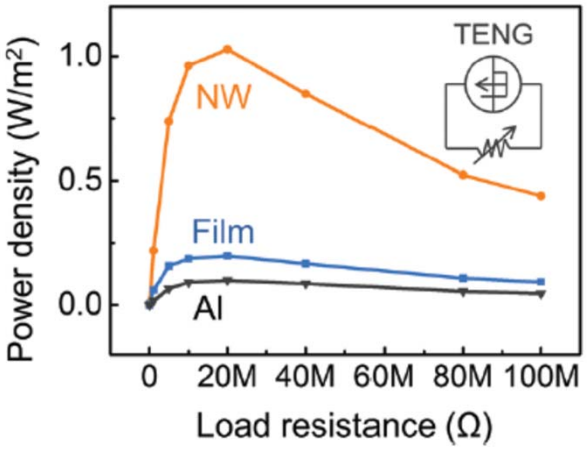

Figure 2. The power generation as a function of variable load resistance for different triboelectric nano generators: NW Nylon-11 nanowires; Film – Nylon-11 film; and Al – aluminium film (all compared to a Teflon counter-electrode).

Key Features

- Simple, scalable method to make strongly tribo-positive self-poled Nylon-11 nanowires
- Power output of ~1W/m^2 - a ten-fold increase compared to standard triboelectric generators, and enough to power small electronic devices
- Harvests energy from a wide range of vibrational frequencies (0-10Hz or more)

Commercialisation

This technology is protected by a patent application. We are seeking industrial partners to evaluate our material and/or develop application concepts. If you are interested in working with us, please contact us using the details on the front of this sheet.