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THE USE OF HUMAN POWER TO GENERATE ELECTRICITY

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Introduction

The sources of energy available for harvesting are essentially of four forms: light, radio-frequency (RF) electromagnetic radiation, thermal gradients, and motion, including fluid flow. All have received attention, in varying degrees. Energy harvesting generators are attractive as inexhaustible replacements for batteries in low-power wireless electronic devices and have received increasing research interest in recent years. This article deals with new and unusual technologies used to harvest power and produce it at low scales.

Nanogenerator

Many scientists all over the world are concerned with the problem to create a nanogenerator converting mechanical energy into electrical one at the same voltage as batteries do. The first mini- device converting mechanical energy into electrical one was created in 2008. Professor Zhong Lin Wang of the Georgia Institute of Technology and his colleagues developed two nanogenerators, which were very thin and tiny. This generators were as small as a (paper) clip. After Zhong Lin Wang has introduced a basic configuration of VING (Vertical nanowire Integrated Nanogenerator (VING)). In 2006 where he used a tip of atomic force microscope (AFM) to induce the deformation of a single vertical ZnO nanowire, the first development of VING is followed in 2007.

Nanogenerator is the term researchers use to describe a small electronic chip or technology that can use mechanical movements of the body to generate electricity by small-scale physical change.

There are three typical approaches in nanogenerator technology: piezoelectric, triboelectric, and pyroelectric nanogenerators. “Both the piezoelectric and triboelectric nanogenerators can convert the mechanical energy into electricity. However, the pyroelectric nanogenerators can be used to harvest thermal energy from a time-dependent temperature fluctuation."(Wikipedia)

The key components of the first nanogenerator are nanoconductors made from zinc oxide. Zinc oxide is a piezoelectric material which converts mechanical voltage into electrical one. Every nanoconductor is several hundred nanometers thick. Nanoconductors are stacked into rows with electrical conductors layers between them. When the nanogenerator was compressed it generated 0,24 volts. This voltage is enough to charge two nanosensors developed by scientists. One nanosensor is intended to measure liquid acidity, another one to detect ultraviolet radiation.

Besides being incredibly small and responsive, nanogenerators are increasingly powerful. In March 2011, researchers measured the output of five nanogenerators stacked together. This tiny stack produced a current of about one microampere, which produced three volts of energy, about the same as two batteries. The key components inside a nanogenerator are nanowires or a similar structure made from a **piezoelectric** ceramic material.

The fabric-like geometrical configuration has been suggested by Professor Zhong Lin Wang in 2008. The piezoelectric nanowire is grown vertically on the two microfibers in its radial direction, and they are twined to form a nanogenerator. One of the microfibers is coated with the metal to form a schottky contact, serving as the counter electrode of VINGs. As the movable microfiber is stretched, the deformation of the nanostructure occurs on the stationary microfiber, resulting in the voltage generation. Its working principle is identical to VINGs with partial mechanical contact, thus generating DC electrical signal.

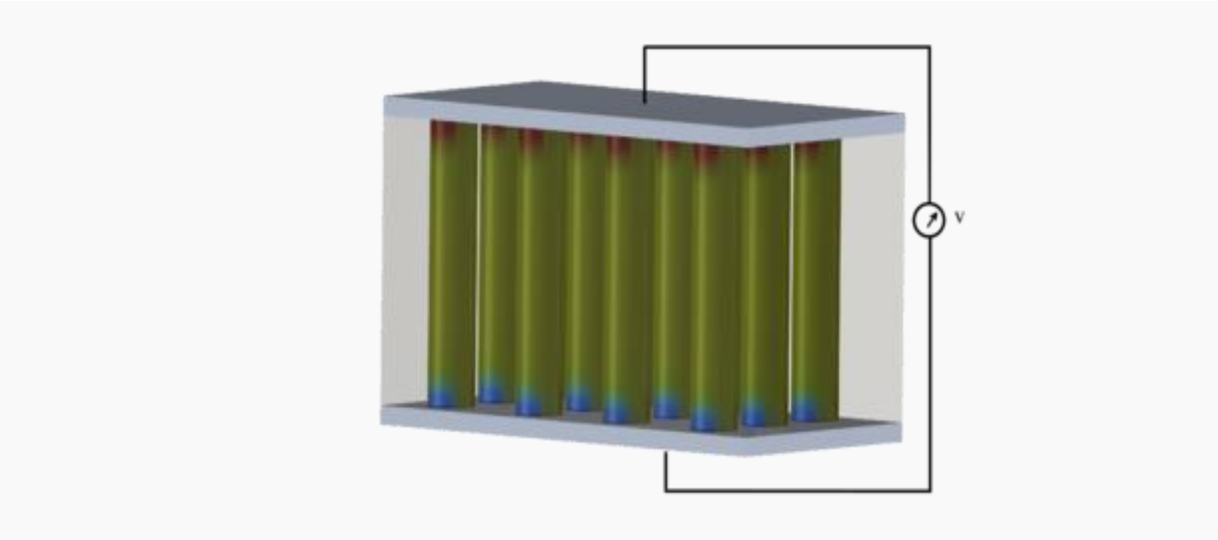

Fig. 1 – Schematic view of typical Nanocomposite Electrical Generator

Piezoelectric materials can generate an electric current just by being bent or stressed. As described in How Nanowires Work, hundreds of nanowires can be packed side by side in a space less than the width of a human hair. At that scale, and with the combined flexibility of the nanogenerator's components, even the slightest movement can generate current.

"NEG" is a 3-dimensional configuration consisting of three main parts: the metal plate electrodes, the vertically grown piezoelectric nanostructure and the polymer matrix which fills in between in the piezoelectric nanostructure.

This generator has a higher efficiency compared to original nanogenerator configuration and provides an energy source with higher sustainability.

Engineers from the Georgia Institute of Technology have developed a transparent device that generates electricity at a pressure and friction. This research is very promising and in the future, such a device can be self-powered or touchscreens become the basis of pressure sensors. The work was published in the journal Nano Letters and attracted attention of many scientists.

“The novelty of this work lies in the fact that the authors have found some form of interacting surfaces for optimal separation of charges.” The main parts of the unit are two plates, consisting of different polymers. When friction electrons from one of the second moving plate, thus creating the potential difference.

Generators operating on the basis of friction are called "triboelectric". To avoid the recombining of the generated sealing contact which leads to electricity generation efficiency decrease, immediately after the charge separation is required to isolate from each other and take the contacts. The air gap between the plates is used as insulator.

It has been found that the efficiency of charge generation in the device depends on the shape of the contacting surfaces. During the experiments, scientists created using photolithography wafers with different surface structure and used as a mold for casting a polymer.

Different surface structures (rectangles, pyramids and smooth surfaces) were tasted. It was found that most efficiently produces electricity polymeric friction plates, one surface of which carries projections in the form of pyramids size of several micrometers.

The prototype device created by scientists proved to be very sensitive. It is generated at a pressure signal in 13 millipascal. Since the polymers used were almost transparent and sensitive, the developed polymers can create sensitive touch screens, which when touched will themselves produce energy for their work [1].

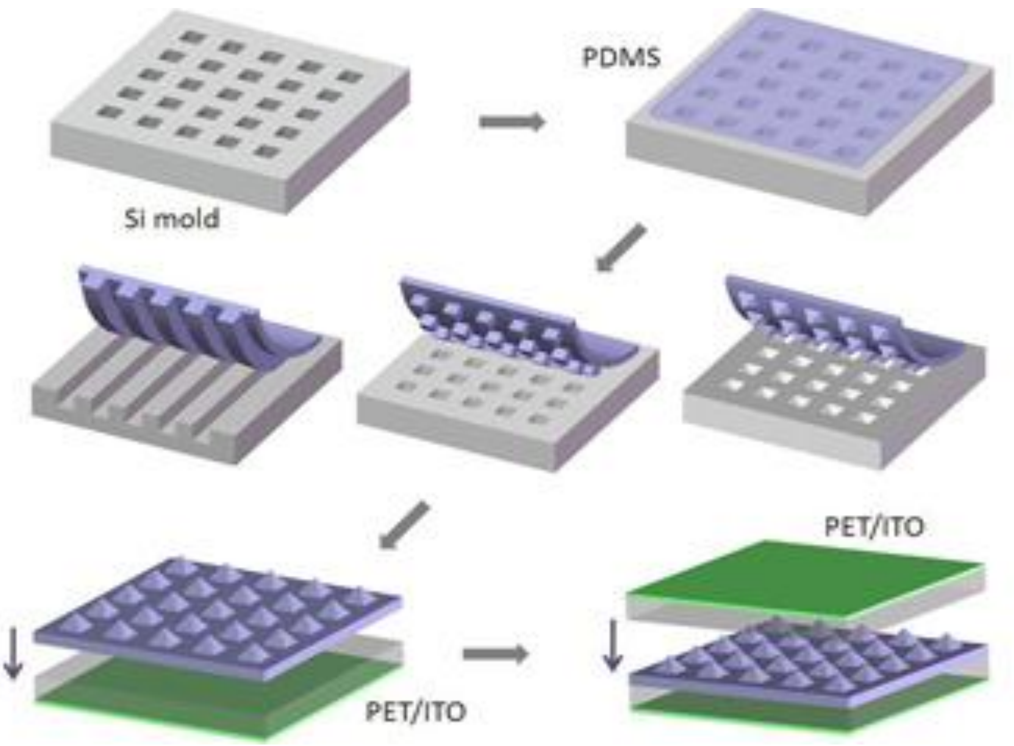

Fig. 2 – Plates consisting of different polymers

Motion as a source of power

Fifteen-year-old Angelo Casimiro from the Philippines and **four US mechanical engineering students at Rice University in Houston** have just invented a smart shoe sole that produces enough electricity when you walk to charge small USB devices. The device consists of piezoelectric materials, which can generate **400 milliwatts** of an alternating current voltage when actuated. It produces current enough to charge a mobile phone.

Energy Harvesting From Human and Machine Motion for Wireless Electronic Devices Practical miniature devices are becoming available for harnessing kinetic energy as a substitute for batteries in medical, and many other, low power applications. Ambient motion is one of the main sources of energy for harvesting, and a wide range of motion-powered energy harvesters have been proposed or demonstrated, particularly at the microscale.

Motion-driven microgenerators which operating principle of a direct-force generator is shown in Fig. 3 utilize direct application of forces and make use of inertial forces acting on a proof mass.

There are two different two structures of mechanical contact of direct force generators. The operating principle of inertial macrogenerators is illustrated in Fig. 4 [2].

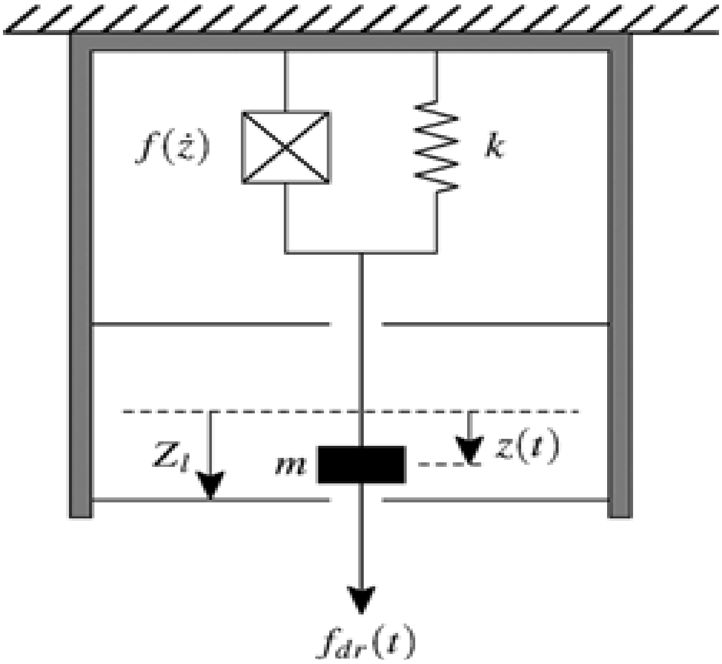

Fig. 3 – Generic model of direct-force generator

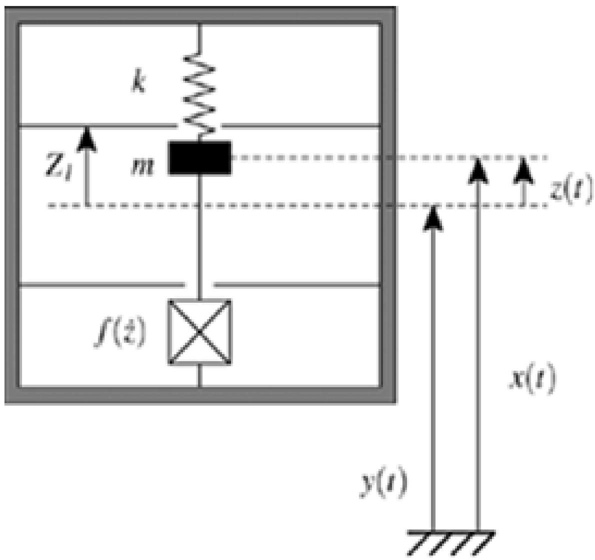

Fig. 4 – Generic model of inertial generator

Decoration to generate electricity

Israel inventor Kizhner Naomi (Naomi Kizhner) has developed a decoration, which uses the energy of the human body to generate electricity. This project is an attempt to find alternative ways of cultivating power, harvesting it directly from the body. Simple movements performed by a man are fully utilized by invasive gold & biopolymer devices that must be embedded into the surface of the skin. The decorations suggested to produce power are: The Blinker (shown in Fig.5), the e-pulse conductor (shown in Fig.6) and blood bridge (shown in Fig.7). The first device (the blinker) operates on the motion of eyes.

The ‘e-pulse conductor’ harvests energy from pulses sent directly from the neurological system to its location on a person’s back near the nape.

Fig. 5 – Blinker

Fig. 6 – E-pulse conductor

The ‘blood bridge’ is embedded into the forearm below the wrist and power is harvested as the heart pumps fluid throughout the veins and organs [3].

Fig. 7 – Blood bridge

Conclusion

The presented above technologies: nanogenerators, shoes which produce electricity, motion as a source of energy, decoration to generate electricity, are only prototypes that show unlimited possibilities to produce renewable and echo-friendly energy. The main advantages of these technologies are their convenience and availability. The scientists hope that with time these prototypes could be introduced at commercial scale.

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THE USE OF GRAPHICAL VISUALS IN STUDYING ENGLISH FOR SPECIFIC PURPOSE IN MODERN UNIVERSITY

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Among the principles existing in the modern didactics concerning the discipline “Professional English” the use of visual methods is directly connected with the necessity to acquire bulk of theoretical material of high level of abstraction. In accordance with the above mentioned fact the teaching-learning process is associated with the application of visuals, such as tables, graphs, diagrams, mind maps which help present information compact by its analyzing and generalizing. Graphical methods of presentation information are useful tools to visualize and simulate complex phenomena and processes.

The wide use of information technologies requires new modern approaches to the development of didactic tutorials and the use of these tools at lessons.

Modern information technologies such as multi and hypermedia ones allow to improve graphical tools (tables, curves, diagrams and etc.) making them interactive, multilevel and its content and methodology satisfying the aims, objectives and conditions of teaching in modern institutes of higher education.

The implementation of new graphical tools based on information technologies into education process in institutes of higher education is not only an attempt to realize all advances proposed by the methodologists but necessity to place at the disposal of educational specialists all tools capable to enhance the level of education quality.