Generation of electricity from Environment energy by Nano generator

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Abstract: A group of researchers and researchers are trying to use the vibrations and vibrations in the environment and provide a power source by means of Nano generators for electronic devices that consume low power; In this case, there will be no need for a battery. The output voltage and current of the Nano generator is so high that it can be used for micro / Nano systems such as self-charging sensors or small implants that can be implanted in the body and microdots and Nano robots. In this article, by describing some of the achievements of researchers and experiments, the mechanism of Nano generators, their uses, and their applications are discussed.

Keywords: *electricity, Environment, energy, Nano generator, Nano systems*

1. INTRODUCTION

Lack of energy as well as the uncontrolled emission of greenhouse gases are a major concern for 21st century humans. Therefore, in today's world, the development of alternative energies is essential [1,2]. For clean energy as an alternative to fossil fuels, a wide range of methods has been proposed and extensive research has been provided. Since the application of nanotechnology in the energy sector is very wide [3], this technology is a good stimulus for research and development in the field of clean alternative energy [4]. In this way, nanotechnology can be relied upon to achieve environmentally friendly energy [5]. Vibration is one of the most common phenomena in our daily lives; Therefore, researchers and scholars have paid special attention to this available and free energy and have always sought to generate electricity from vibrations. In this regard, the Nano generator is one of the tools that many studies have been done about, because the slightest movement or vibration can give enough energy to the Nano generator to generate electricity. In this way, Nano generators can be used in the design of cells and self-charging sources [6,7].

2. Nano generator mechanism

A Nano generator is a nanostructured energy generating device that converts external kinetic energy into electrical energy. Although its definition may include any type of nanostructured energy extraction device (such as solar energy [8] and thermal energy [9]), most of the time electricity is generated by Nano generators by converting energy from piezoelectric materials [10].

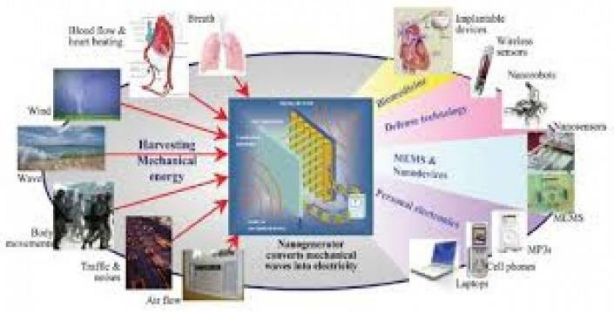

Figure 1. Scheme of electric current generation by a piezoelectric Nano generator based on zinc oxide nanowires by absorbing the mechanical energy of the environment and also a view of the potential applications of Nano generators for the future [16].

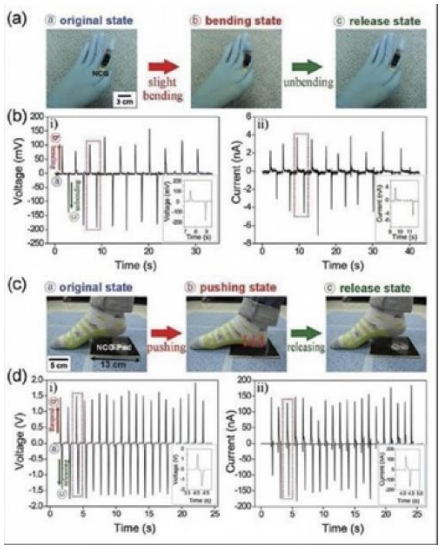

Figure 2. (a) a small-scale nanocomposite generator (4.1 5.1 cm^2) bent and released by a human finger; (b) display of output voltage and current signals due to human finger movement; (c) a large-scale nanocomposite generator (with an area of 13.13 cm^2) is shown; (d) Generating voltage and current signals due to foot movement [18].

Piezoelectric nanotechnology technology converts non-polluting energy sources, such as mechanical and vibrational energy of wind and waves, into unlimited electrical energy for human use. This technology has attracted a lot of attention. However, prior technologies in this area have problems such as process complexity, high cost, and limited size. Recently, a research team from the Korea School of Materials Science and Engineering has developed nanocomposites based on nanocomposite materials that can overcome the problems of previous models and provide a relatively inexpensive, simple, and large-scale self-energizing system (figure3-4).

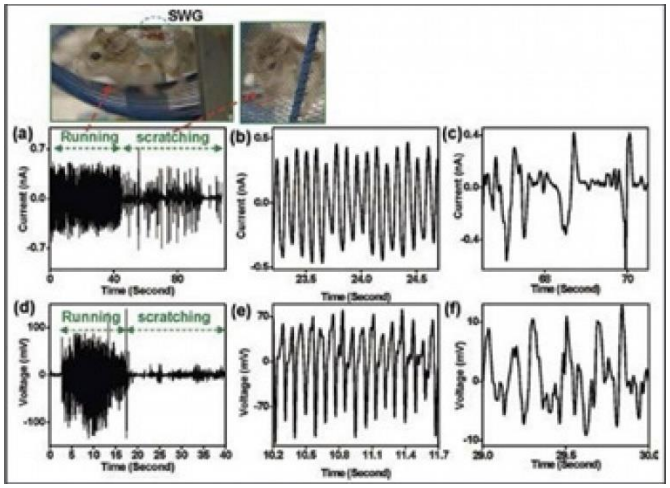

Figure 3. Extraction of electricity from the movement of mice by a single-core generator; (a) to (c) show the output current of a single-stranded generator while the mouse is running or scratching, and (d) to (f) show the output voltage when the mouse is running or scratching itself [31].

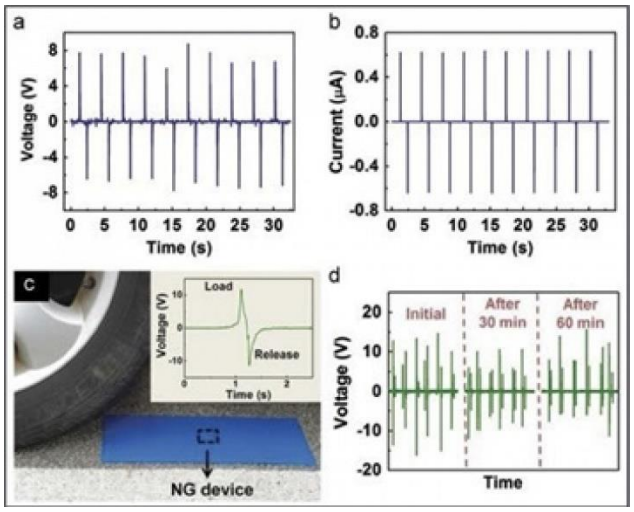

Figure 4. Energy collection by passing car tires through the Nano generator; (b), (a), and (d) represent the output voltage and current signals, and (c) represent the moment the tire passes through the Nano generator [33].

The researchers first mixed the piezoelectric nanoparticles with carbon nanomaterials (carbon nanotubes and reduced graphene oxide) in a polydimethylsiloxane substrate and produced a nanocomposite generator using a simple rotary or rod coating method. As shown in Figure 2, the resulting piezoelectric material bends to create an electric current. In their research, they were able to obtain a maximum voltage of 2.3 volts and a current of 350 Nano amperes, and by storing this current in a capacitor, they were able to turn on an LED lamp [18]. It is noteworthy that in addition to fabricating Nano generators using piezoelectric properties of zinc oxide [19], researchers have succeeded in applying the piezoelectric properties of nanowires and nanofibers of titanium lead zirconated [21,20], cadmium sulfide [23,22], titanium [24], polyvinylidene fluoride [27,26] and gallium nitride [28], to generate electricity from ambient energy. Recently, a research team has been able to reach a voltage and current equal to 6 volts and 45 Nano amperes by Nano generators based on lead zirconated titanium nanowires [29]. As mentioned earlier, Nano generators can be widely used and can be used in many places. A hybrid Nano

generator is made that combines two types of solar energy and mechanical energy and can be used to generate energy instead of conventional batteries. This Nano generator uses two previously invented technologies to generate electrical potential. One of these technologies is the thin membrane of solar cells, and the other is a Nano generator that is placed under the layer of silicon membrane and generates electrical potential on oxide nanowires. Researchers are trying to increase the output power of this tool by using multiple layers of Nano(figure5-6) [39].

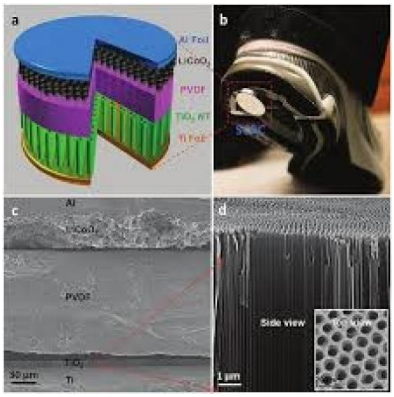

Figure 5. Design of the structure of a self-charging cell by piezoelectric and a lithium-ion battery; (a) Schematic diagram of the structure of a self-charging cell. The anode is an array of titanium oxide nanotubes grown on lithium foil and its cathode is made of cobalt lithium oxide which is placed on aluminum foil and a layer of polyvinylidene fluoride is placed between the anode and the cathode as a separating material; (b) a self-charging cell attached to the underside of the shoe is displayed which can convert the compressive energy from walking directly into electricity; (c) display an image taken of the cross-section of a self-charging cell by scanning electron microscopy; (d) Enlarged image of titanium oxide nanotubes taken by scanning electron microscopy [34].

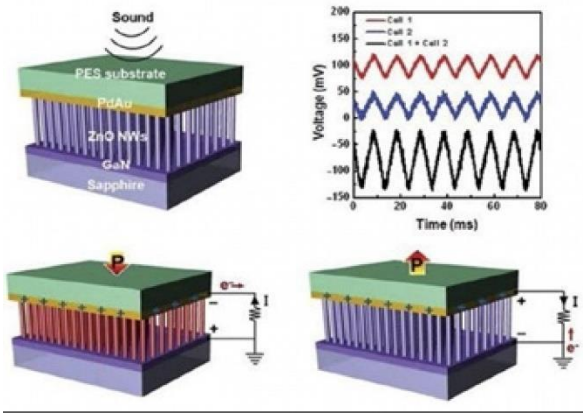

Figure 6. Generation of potential and output current in a Nano generator due to sound waves hitting zinc oxide nanowires [38].

3.Electrical energy efficiency of Nano generator

The energy conversion efficiency of the Nano generator is an important parameter for energy collection and extraction applications. Efficiency can be calculated by comparing the output electrical energy with the input mechanical energy (applied to the piezoelectric). Electrical

energy (We) is obtained by multiplying the output voltage of the Nano generator (V) by its output current (I). Elastic strain energy (W_s) is estimated by the following equation:

$$W_e = \int VI\, dt \quad \&$$

$$W_s = \frac{1}{2} EA\varepsilon^2 L_0 = \frac{1}{8} E\pi D^2 \varepsilon^2 L_0$$

E is equal to the Young's coefficient of elasticity, A is the cross-sectional area, D is the diameter of the nanofiber, ε is equal to the strain applied to the material, and L0 is the length of the material [40]. With an experiment on polyvinyl fluoride nanofibers and 45 types of polyvinyl fluoride nanofibers with diameters between 500 nm and 5.6 μm and lengths between 100 and 600 μm, researchers have observed that the energy produced by this method can be up to 21 / 8% and with an average return of 5.12%. According to preliminary results, the shrinking process of nanofibers increases the efficiency of electrical energy production from Nano generators. Therefore, it can be concluded that energy production efficiency may be higher in the future [41].

4. Conclusion

Since Nano generators will no longer require wires and batteries, they can be a very good source of energy for micro and Nano systems such as microdots, wireless sensors, and low-power electronics. Also, although one of the salient advantages of using Nano generators is that Nano processors can have a self-charging energy source, it is important to note that with today's technology, little energy is received from the piezoelectric material of Nano generators. What is certain is that Nano generators in the future could be used in many fields as a stable, clean, and low-volume energy source.

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