

A Step Towards Achieving Self-Sufficient Energy Generation from Human Movement and Action by Application of Piezo- Nano generators

Prof. Rahul Somalwar, Prof. P. Chaudhary Mr SubarnaMukherjee

Abstract: It is taken for granted that energy generation is always less than the energy demand. Most of the energy generated worldwide is used up for domestic purposes that include illumination, cooling, heating etc. loads. Domestic self-sufficiency can be achieved by employing solar panels, erecting wind turbines and other non-conventional sources of energy. We can also explore new ways involving extraction of energy that nature has on offer. Human physical motions, for ex: have substantial potential to run our homes with self sufficient energy. Although the imminent methods to extract these energies are fairly limited, the techniques available are very effective. Nano generators are used for piezoelectric harvesting of electrical energy from physical actions like walking, running, jumping and bending. According to a study, 70 watts of energy is liberated by a footstep of an average human being. We are at all able to harvest this energy we can definitely achieve self sufficient energy generation. artificial photosynthesis, and tidal power, and also technologies designed to improve energy efficiency.

The need for self-sufficiency arrives from the fact that energy generated is less than demand.

Since the amount of energy consumed by domestic loads is the maximum, we need to look forward to self-sufficient energy generation in homes, offices and public areas. With the entire world busy making efforts to find an alternative fuel as a source of energy, self-sufficient energy generation offers saving in fuel consumption. Nature has a lot of self-sufficient energy sources on offer. There are many forces and energies in nature that can, perhaps, be used to our benefit.

An average human being generates 70 watts of energy from a single footstep alone. If we could somehow make use of such energies from nature, we may achieve self-sufficiency.

Keywords: Nano generator, Self -sufficient energy,

I. INTRODUCTION

Sustainable energy is the sustainable provision of energy that meets the needs of the present without compromising the ability of future generations to meet their needs. Technologies that promote sustainable energy include renewable energy sources, such as hydroelectricity, solar energy, wind energy, wave power, geothermal energy, artificial photosynthesis, and tidal power, and also technologies designed to improve energy efficiency.

Prof. Rahul Somalwar is working as Asst. Professor & Head, in Department of Electrical Engg., Datta Meghe Institute of Engineering Technology & Research, Wardha,(M.S.) India. rahulsomalwar@gmail.com

Prof. P. Chaudhary is working as Head, Department of Physics Datta Meghe Institute of Engineering Technology & Research, Wardha,(M.S.)Indiapchaudhari2007@rediff.com

The need for self-sufficiency arrives from the fact that energy generated is less than demand. Since the amount of energy consumed by domestic loads is the maximum, we need to look forward to self-sufficient energy generation in homes, offices and public areas. With the entire world busy making efforts to find an alternative fuel as a source of energy, self-sufficient energy generation offers saving in fuel consumption. Nature has a lot of self-sufficient energy sources on offer. There are many forces and energies in nature that can, perhaps, be used to our benefit.

II. PROPOSED METHODOLOGY

We do have a lot of energy flowing in nature in various forms, what we need is an efficient transduction system that would be able to give us the maximum amount of energy possible. The solution is provided by nature itself. There are various substances in nature that can produce electrical energy from mechanical stresses. These substances are known as piezoelectric materials. These materials work on the principal of piezoelectric effect. Piezoelectricity is the electric charge that accumulates in certain solid materials (notably crystals, certain ceramics, and biological matter such as bone, DNA and various proteins) in response to applied mechanical stress. The word piezoelectricity means electricity resulting from pressure. The direct piezoelectric effect is defined as electric polarization produced by mechanical strain in crystals belonging to certain classes. In the converse piezoelectric effect a piezoelectric crystal gets strained, when electrically polarized, by an amount proportional to polarizing field.

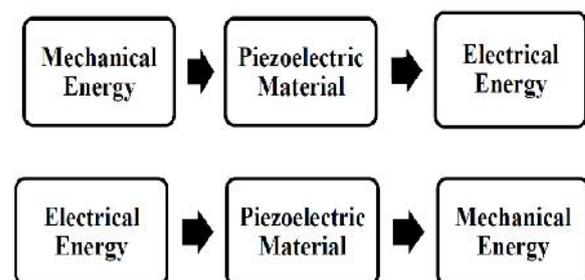


Fig 1Two way Energy Flow Diagram

Piezoelectric effect can prove to be the most important source of sustainable energy generation.

Materials like Quartz, Rochelle salt, Zinc oxide, etc. exhibit properties of piezoelectricity. What we need to do to extract energy from physical motions of humans (walking, running,

bending etc.) is make a harvesting device called the ‘Nanogenerator’.

Nanogenerator is a technology that converts mechanical/thermal energy as produced by small-scale physical change into electricity. Nanogenerator has three typical approaches: piezoelectric, triboelectric, and pyroelectric nanogenerators. Piezoelectric Nano generator is an energy harvesting device converting the external kinetic energy into an electrical energy based on the energy conversion by nano-structured piezoelectric material. Although its definition may include any types of energy harvesting devices with nano-structure converting the various types of the ambient energy (e.g. solar power and thermal energy), it is used in most of times to specifically indicate the kinetic energy harvesting devices utilizing nano-scaled piezoelectric material after its first introduction in 2006.

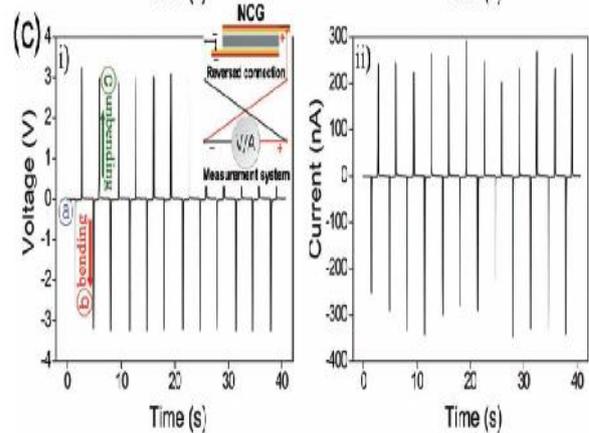
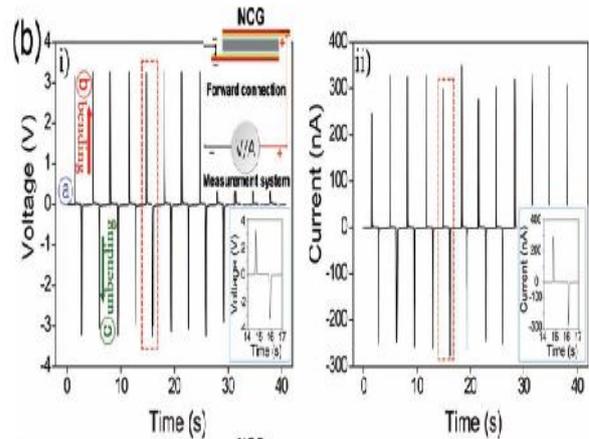
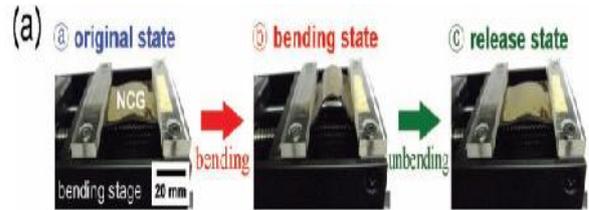
Another mechanism that can be employed for energy generation is the triboelectric effect. The triboelectric effect (also known as triboelectric charging) is a type of contact electrification in which certain materials become electrically charged after they come into contact with another different material through friction. Rubbing glass with fur, or a comb through the hair, can build up triboelectricity. Most everyday static electricity is triboelectric. The polarity and strength of the charges produced differ according to the materials, surface roughness, temperature, strain, and other properties. The effect is greatly enhanced by rubbing the materials together, as they touch and separate many times. For surfaces with differing geometry, rubbing may also lead to heating of protrusions, causing pyroelectric charge separation which may add to the existing contact electrification, or which may oppose the existing polarity. Surface nano-effects are not well understood, and the atomic force microscope has made sudden progress possible in this field of physics.

Both these processes can be incorporated in order to achieve sustainability. This paper basically deals with the use of nanogenerators in floor materials to extract the maximum energy possible from human actions like walking, running, driving etc. For it to be applicable there can be two mechanisms, placing a nanogenerator in a shoe or making our floors piezo-sensitive. We are going to discuss the second mechanism. Is it indeed possible to make our flooring systems sensitive to human actions? We, for ex: we can build piezo-sensitive tiles with an in-built nanogenerator system that converts mechanical stress to electrical energy. The layout of the tile is as follows;

Above is the cross-sectional view of the nanogenerator based floor tile that could empower almost all domestic loads. The strips here are piezoelectric; we can also employ triboelectric strips consisting of kapton and polyesters as their core ingredients. In its simplest form, the triboelectric generator uses two sheets of dissimilar materials, one an electron donor, the other an electron acceptor. When the materials are in contact, electrons flow from one material to the other. If the sheets are then separated, one sheet holds an electrical charge isolated by the gap between them. If an electrical load is then connected to two electrodes placed at the outer edges of the two surfaces, a small current will flow to equalize the charges.

These materials offer a cheaper solution to the problem as compared to their piezoelectric counterparts.

Results and Discussion



Above is the output for BaTiO3 and MW-CNT based nanogenerator. The mechanical stress is given by constant bending and unbending of the nanogenerators. Physical set up prepared in the lab by using the available resources and take the readings at different conditions.



Fig.a

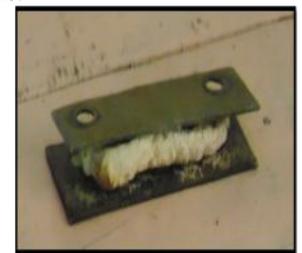


Fig.b

**Fig.a) Paste coated in the form of thick film
Fig.b)Nano generator based upon Copper Plates**

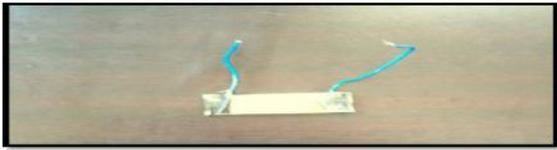
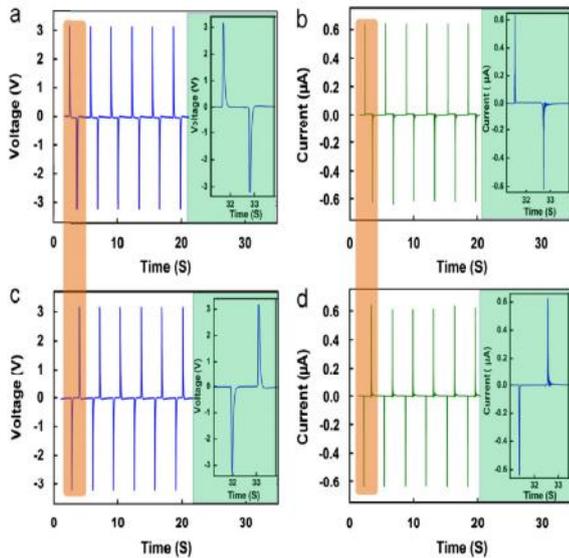


Fig c. Fabricated Nanogenerator



These are the output characteristics of triboelectric generator. The current output is better than that of piezoelectric generator. Triboelectric generator is also cheaper. Comparative power output is far better.

Advantages of the proposed solution:

1. Potential of a piezo-sensitive floor in public areas like Railway Stations, Bus stops, Auditoriums, Stadiums etc. can redefine large scale energy generation.
2. Powering Domestic Loads.
3. Powering Office space.
4. Piezo Sensitive Floor in Colleges and other institutions can offer a lot of energy output.
5. Freedom from electric bills.

III.

Conclusion:

The paper is a brief overview of a nanogenerator based sustainable energy generation solution for empowering domestic loads. The nanogenerators are based on two principles; the piezoelectric and triboelectric effects. The benefits of this kind of generations have been discussed as above. Self-sufficient energy generation can be path breaking for time to come. Materials need to be identified in order to provide for the energy generation in the cheapest and the most efficient of ways. Floor tiles consisting of nanogenerators can be very effective for the same.

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Mr Rahul Somalwar, has completed his Diploma in Electrical Engineering and done his graduation in Electronics & Power Engg in 2000. Completed his M.E in Power electronics from RGPV, Bhopal in 2009. He is having industrial experience, had worked as Executive Engineer in Ballarpur Paper Industry Pune. From last 14 years he had worked as Faculty in Engineering College. Presently working as Head, Department of Electrical Engineering DMIET, Wardha. The area of interest is Power electronics and power system stability

Second Author



Mr Prashant R. Chaudhari has completed post graduation in Physics in 2003 from Department of Physics R.T.M. Nagpur University, Nagpur. He is having 11 years of teaching experience to science and Engineering undergraduate students. He has many publications to his credits in national - international conferences and

journals. Presently working as Head, Department of Applied Physics, DMIETR, Wardha. His area of interest is nano ferrites for gas sensor and other applications

Third Author Mr Subarna Mukherjee Completed his B.E in 2014. Work on this topic during his project. Presently working in Tech Mahindra.