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THE FABRICATION OF FLEXIBLE HYBRID NANOGENERATOR FOR SELF-POWERING DEVICES

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ABSTRACT

Recently research trend indicates that piezoelectric based nanogenerator is one of the rapid grown working areas because of the demand of self-powering portable electronic devices, e-heathcare, smart textiles and applicability as ultrasensitive pressure sensors. In this work, an improved performance of flexible hybrid nanogenerator (HNG) is fabricate based on poly(vinylidene fluoride–hexafluoropropylene) [P(VDF-HFP)] composite with ZnO nanoparticles. This nano composite is prepared by simple solvent casting method followed by etching of ZnO nanoparticles. It has been found that even without any electrical poling treatment of the nano composite films, the peak value of the open-circuit voltage is found to be about 8.5 V when the cross section area of the HNG is about 1.96 cm^2. Furthermore, we demonstrate the repeated human finger impact on the top surface of the HNG can charged up the capacitors and it can directly powered more than 20 commercial light emitting diodes (LEDs), indicating an effective way of energy harvesting power source for portable electronic gadgets.

Keywords: ZnO Nanoparticles, [P(VDF-HFP)], Hybrid Nanogenerator (HNG), Piezoelectric Energy harvester.

INTRODUCTION

Recently "self-powered nanotechnology" with the aim to build self-powered systems that operate independently, sustainably, and wirelessly without the use of a battery is becoming one of the important research areas due to increasing demands of portable electronic devices [1]. One of the great applications for such a self-powered system is that it can be used for driving portable/wearable personal electronics in our daily life Nanogenerators (NG) are one of the technologies that are developed to harvest irregular mechanical energy with variable frequency and amplitude in our environment by way of the piezoelectric effect [2]. Such energy forms are abundant in the working environment for personal consumer electronics. In fact, after sustainable development the HNG has been demonstrated to power small electronic devices, such as the lighting of a small LCD screen of a calculator and flashing a single LED.

This research illustrated the possibility of realizing self-powered electronic systems, which is a greatly desired concept for developing care-free sensor networks, implantable biomedical devices, and next-generation personal electronics. Here β-Phase P(VDF-HFP) composite organic material have been used to design the flexible HNG [3]. Due to its high piezoelectric coefficient, excellent stability, and desirable flexibility, nanostructured P(VDF-HFP) polymer has been used in a variety of HNG designs for mechanical energy harvesting. Combined with its high mechanical resistance, dimensional stability, and chemical stability, the flexible P(VDF-HFP) polymer holds good potential for integratable HNGs in self-powered electronic systems.

In order to enhance the piezoelectric performance, P(VDF-HFP) should possess well controlled nano morphology, high purity of the β-phase, and excellent flexibility and durability. The P(VDF-HFP) thin films were fabricated using a simple casting-etching process in the wafer scale. The P(VDF-HFP) HNGs can be directly attached to the surface of an electronic device (e.g., a cell phone) and effectively convert mechanical energy from ambient surface oscillations to electricity using the device's own weight to enhance the amplitude[4]. Recently, piezoelectric ZnO nanowires (NWs) have been demonstrated as a promising concept to harvest micro- and nano-scale mechanical energy from the surrounding—the nanogenerator (NG) [5].

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