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FABRICATION OF POLYVINYLIDENE FLUORIDE PIEZOELECTRIC FILM FOR NANOGENERATORS

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Nanogenerators based on piezoelectricity is a promising technology for energy harvesting, sensors, biomedicine and in many other fields. Properties of piezoelectric material are influential factors to improve the output capability of piezoelectric nanogenerators. Polymer piezoelectric materials, especially polyvinylidenefluoride (PVDF), has attracted attention because of its high flexibility, chemical stability, non-toxicity, biocompatibility and high thermal stability apart from its piezoelectric properties. PVDF is a semicrystalline polymer with four different crystalline phases α, β, γ and δ. In this work, the electrospinning technique was used to fabricate PVDF fiber film to enhance the β phase content, which is responsible for piezoelectricity. The electrospinning process with optimal parameters was carried out to obtain uniform and well-aligned fibers as observed by scanning electron microscopy (SEM). The morphology of the PVDF fiber film, observed by SEM, showed uniform, smooth and consistent fiber formation without beads, and moreover, the fiber diameters were in the range of 700 – 1,000 nm. The crystalline phase of PVDF was characterized by analyzing X-ray diffraction patterns and Fourier transform infrared spectra. The β phase content of the electrospun film was 80.1%, while it was 64.4% for the solvent casted PVDF film. This result showed that electrospinning increases the percentage of the β phase present within the film. A nanogenerator was constructed from assemblies of fabricated PVDF fiber film and copper electrodes. The piezoelectric response of the nanogenerator impacted by the applied force was evaluated by measuring the peak-voltage outputs. Variations in the tapping frequency have not significantly affected the amplitude of the output voltage of the nanogenerator. However, the applied force and detected output voltage are linearly correlated within the observed region. The maximum voltage generated was 1.0 V with finger tapping, and it was 1.3 V with a custom-designed tapping machine. Improvements of this PVDF piezoelectric nanogenerator can be used in many potential applications in several fields, especially as energy harvesters and sensors.

Keywords: Electrospinning, Nanogenerator, Piezoelectricity, Polyvinylidene fluoride