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Piezo-energy harvester of aligned electrospun PVDF nanofibers

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Polyvinylidene Fluoride (PVDF) is a popular piezoelectric polymer because of its high flexibility, biocompatibility and simplicity of production. These features make PVDF attractive in energy conversion applications between mechanical force and electrical power, such as strain sensors, mechanical actuators and energy harvesters. The aforementioned applications rely on the piezoelectric property of PVDF and it is well-known that appropriate mechanical stretching and electrical polarization are essential factors to achieve good piezoelectricity. Electro-spinning processes can provide PVDF fibers mechanical stretching and electrical poling simultaneously and produce ultrafine and well-distributed nanofibers. Furthermore, previous studies discovered that the nanoparticles addition such as carbon nanomaterials or metallic nanoparticles could help improving the β content of the electrospun PVDF nanofibers. In this study, a rotation drum was used to collect aligned PVDF nanofibers during the electro-spinning process. The aligned fiber membranes were collected by changing the electro-spinning parameters of the rotating speed and the applied voltage. The PVDF nanofiber membranes collected by rotating drum showed higher β content and better mechanical property than the membranes collected on a fixed copper grid collector. The results showed that the orientation and contents of β phase of the aligned nanofiber membranes were both increased with the rotating speed and the applied voltage during the electro-spinning process. The β content of the PVDF fiber membrane reached to 87% at rotating speed of 3000 rpm and applied electric field of 1500 V/cm. Moreover, the aligned PVDF nanofibers with Carbon Nanotubes (CNTs) addition exhibited enhanced β phase content. The received PVDF nanofiber membranes were loaded and evaluated by three types of dynamic mechanical forces: Compression, tensile and bending. According to the different types of the mechanical loading, corresponding piezoelectric units were circumspectly designed. The piezoelectric response (electrical output voltage) of the PVDF nanofiber membranes increased linearly with the applied forces and showed good stability during the cyclic loading.

Biography

Wen-Yuan Zeng is currently pursuing her Master's degree in Materials Science and Engineering from National Taiwan University of Science and Technology. She has completed her graduate studies in Materials Science and Engineering from National Taiwan University of Science and Technology.

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