Preparation of a Piezoelectric PVDF Sensor via Electrospinning

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Due to growth in robotics and automation in recent years, tactile sensors, which are designed to detect various information by physical contact, have gained much importance in the development of biomedicine, social assistance and industry. Piezoelectric tactile sensors fabricated from polyvinylidene difluoride (PVDF) are used for sensing vibrations because of their high sensitivity, mechanical flexibility, multi-technology compatibility, stability, and cheaper cost [1]. Generally, piezoelectric materials produce an electrical charge on the surface when stress is applied. Among the polymorphs of PVDF, only the β-phase exhibits piezoelectric properties. As electrospinning involves both mechanical stretching and poling, which facilitate the formation of β-phase, it is the most suitable method to increase the voltage output from a PVDF film [2-3]. In this study, we prepared an electrospun samples from 10-20 wt.% PVDF dissolved in different volume ratios of DMF/acetone and DMF/THF. The suitable solvent and wt.% of PVDF to obtain uniform and high β-phase content fibers were studied.

The analysis of the introduced design of the sensor as two layers of the electrode in between of PVDF was performed using COMSOL Multiphysics software. The simulation study helps to optimize the development of sensors and allow their adjustments by comparing the analytical results of different changes of the output signal, eigenfrequency, vibration amplitude and applied pressure to the film.

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References
[1] R.S. Dahiya, G. Metta, M. Valle, G. Sandini, IEEE T. Robot. 26 (2010): 1-20.
[2] P. Ueberschlag, Sens. Rev. 21 (2001): 118-126.
[3] Y. Xin, J. Zhu, H. Sun, Y. Xu, T. Liu, C. Qian, Ferroelectrics. 526 (2018): 140-151.