Piezoelectric Materials Based Scaffolds Fabrication for Cardiamyocyets Cell Growth

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Abstract

Tissue engineering is concerned on the growth of tissue making organs for implantation back to the donor himself. Instead of using organs transplantation and expose the patient for immunological rejection possibility, implantation is another alternative approach. Artificial scaffolds have to be fabricated base on the targeted organ. The projected scaffolds should have designed shapes with a suitable mechanical toughness, wettability, porosity, biodegradability and biocompatibility. Ideally, the projected scaffold should also allow imitating of the normal cell microenvironment in order to produce a tissue with the same biological functions as found in a body. Cardiomyocytes or cardiac myocytes required specific type of scaffold and in this work we developed a pattern of polyvinylidene fluoride (PVDF), a piezoelectric, fluoropolymer, and a highly non-reactive using electro spinning to form a nanoscale fibers from a liquid as a concept of energy harvesting from heart beating using piezoelectric material. Three different polymer solutions were made using 15%, 12% and 10% of PVDF each in DMF under specific condition and quantities. The second part of this experimental work is to fabricate the PVDF nanofibers from polymer solutions in the presence of conductive graphene nanoplateletes under specific condition and quantities. All produced nanofibers will be characterized and compared using X-ray diffraction (XRD), Electrochemical Impedance Spectroscopy (EIS) and Dynamic Mechanical Analyzer (DMA) for choosing optimal fibers.

Method

Electrospinning uses an electrical charge to draw very fine nanofibers from a liquid.
Fibers with diameters in the nanometer range are created by spinning and controlling streams of electrically charged polymers in a strong electric field applied between the syringe's needle and the collector. Nano fibers will accumulate on the collector.

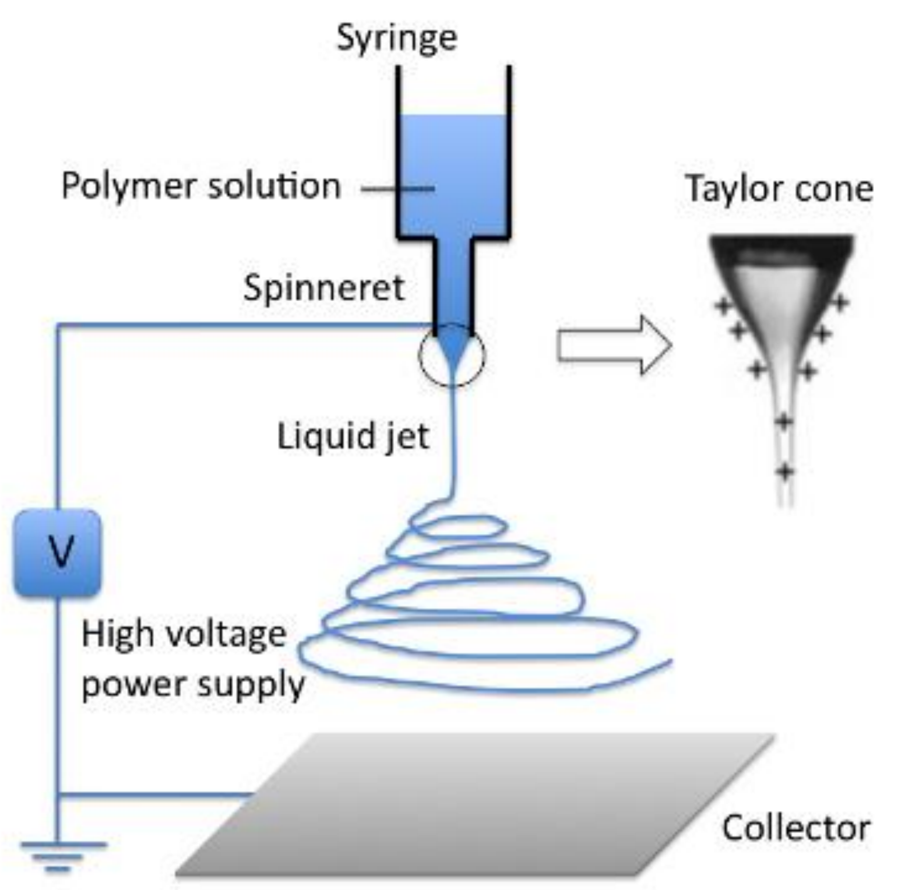

Fig.1 Diagram showing fibers formation by electrospinning.

http://www.intechopen.com/books/nanofibers/core-shell-nanofibers-nano-channel-and-capsule-by-coaxial-electrospinning

Factors Effecting Electrospinning

Three factors has to be taken in consideration for electrospinning.

1. Applied voltage between tip of the needle and the collector.
2. Distance from the tip of the needle to the collector.
3. Flow rate of the solution during the process.

All these variables considered to be the key factor to form nanofibers. In addition, the polymer solution viscosity has been noticed to have a direct correlation in forming fibers.

Polyvinylidene fluoride and Dimethylformamide nanofibers formation

we have added 1.5 g of Polyvinylidene fluoride (15% PVDF) to 10g of Dimethylformamide (DMF) . The Distance between the syringe's needle to the collector was 15 cm. in addition we have applied 15 KV between the needle's tip and the collector. The polymer solution flow rate was 0.5 ml/h. time spent in electrospinning was 2 hours on a stationary collector. We have noticed that formed fibers has a thick layer and can be easily seen in the following pictures. The next step is to add **conductive graphene nanoplateletes .**

PVDF Nanofibers

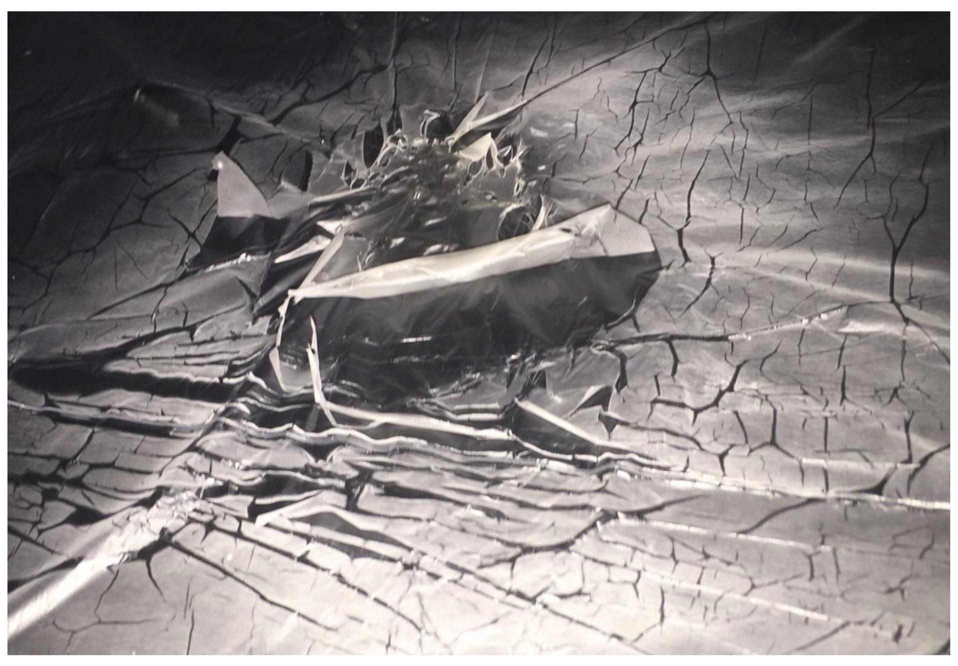

Fig.2 Collected PVDF Nanofibers

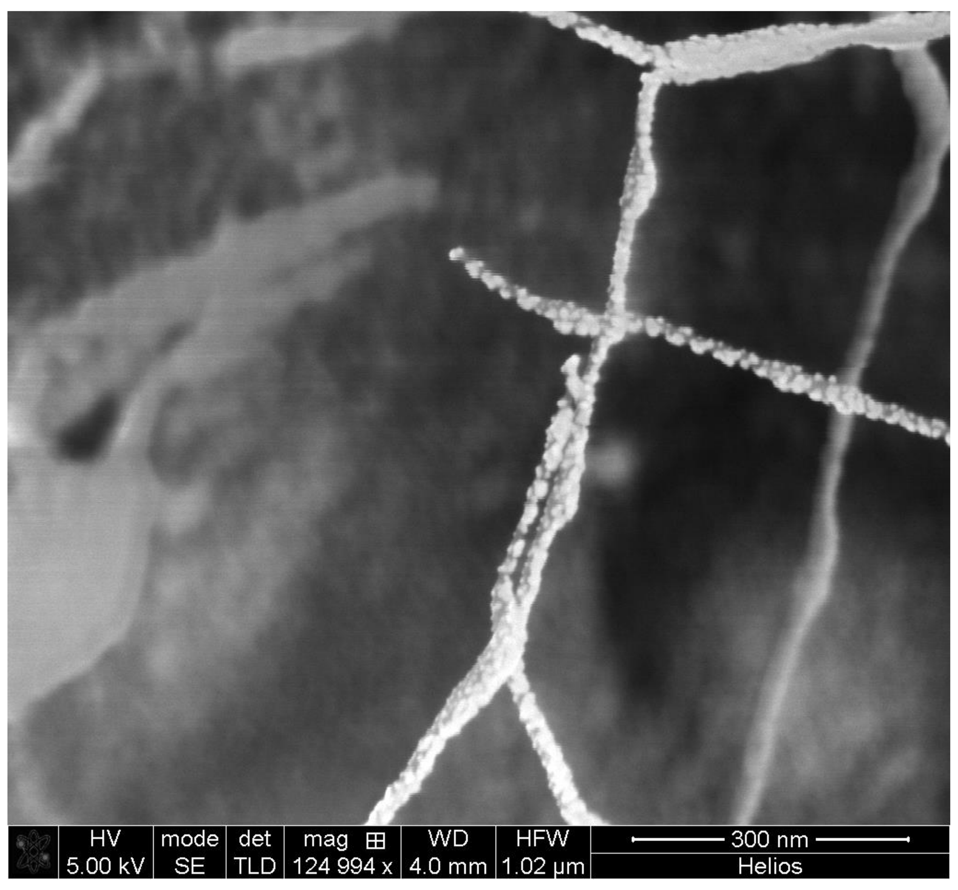

Fig.2 PVDF Nanofibers