Previous
Next
Table of Contents
Search
WWW Home
Contact Us

PHD ULTRA™ Programmable Syringe Pump

A Pump for Electrospinning a Novel Scaffold Fiber Materials

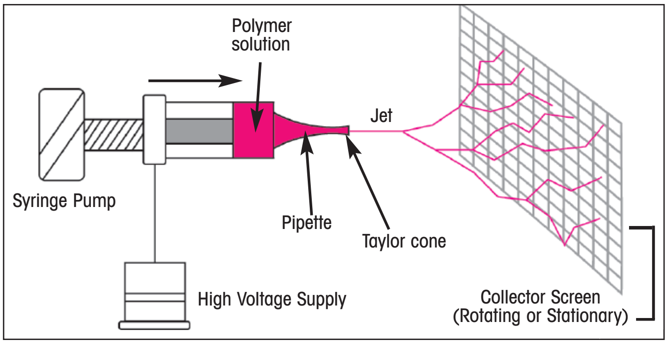

***Figure 1**: Schematic of the Electrospinning setup.*

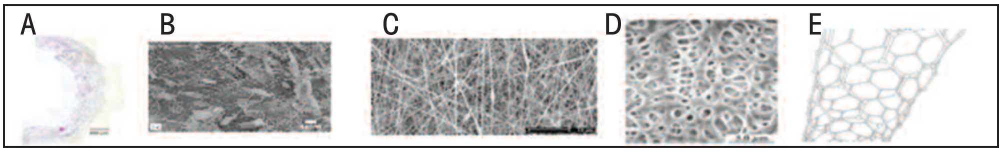

***Figure 2:** (A) Vessel Scaffold, (B) Scaffold for Muscle, (C) Tissue Scaffold, (D) Bone Scaffold, (E) Organ Scaffolds.*

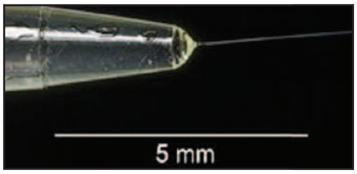

***Figure 3:** Photograph of a meniscus of polyvinyl alcohol in aqueous solution showing a fibre being electrospun from a Taylor cone.*

KEY FEATURES

- **Key Regulator Certifications**
- **Continuous smooth flow without droplet formation**
- **Fully programmable**
- **Ideal for optimization protocols**
- **High Accuracy (+/-0.25%) low flows**
- **Ideal for high viscosity solutions**
- **Rugged design with 2 year warranty**

Electrospinning

Harvard Apparatus' PHD Series of syringe pumps has the highest publication rate out of any available syringe pump for electrospinning. In 1934, electrospinning was patented by Formhals, wherein an experimental design was outlined for the publication of polymer filaments using electrostatic force. Electrospinning is done by using a high voltage to create an electrically charged jet of polymer solution, or melt, which dries or solidifies leaving a polymer fiber.

Optimally labs use a high accuracy, ultra smooth syringe pump to deliver a constant stream to pulled spray nozzle. A driving electrode is placed into the melt at the nozzle top and another electrode is used as a ground inside of the collector, typically a wire mesh. A high voltage (30kV) is passed through the driving electrode, which creates an electric field on the surface of the liquid. The strength of the electric field is exactly opposite that of the surface tension of the liquid, creating a further increase in the intensity of the existing electric field. The surface of the liquid changes into a hemisphere and elongates into a conical shaped called the Taylor cone (reference, figure 3).

Once the electrostatic force overcomes the surface tension a charged steam of fluid is ejected from the Taylor cone, the exact value is considered the critical value. The stream is collected at the ground and once it dries forms polymer fibers. The process is controlled through speed of the fluid from the syringe pump and the magnitude of the electric field.

Variables:

1. **Molecular Weight, Molecular-Weight Distribution and Architecture**
2. **Solution Properties: Viscosity, Conductivity, Surface Tension**
3. **Electric Potential, Flow Rate, Collection Screen**
4. **Distance between capillary and collection screen**
5. **Ambient Parameters: temperature, humidity, chamber air velocity**
6. **Motion of the Target Screen (collector) and chamber Air Velocity**

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