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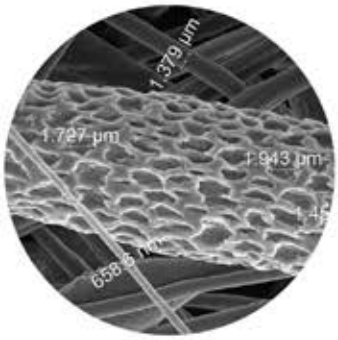
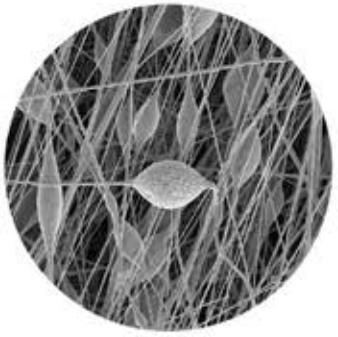
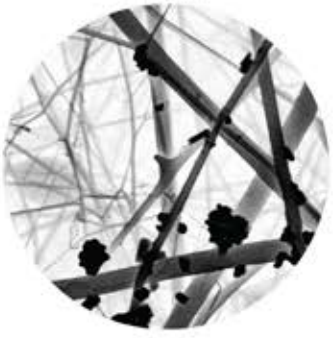
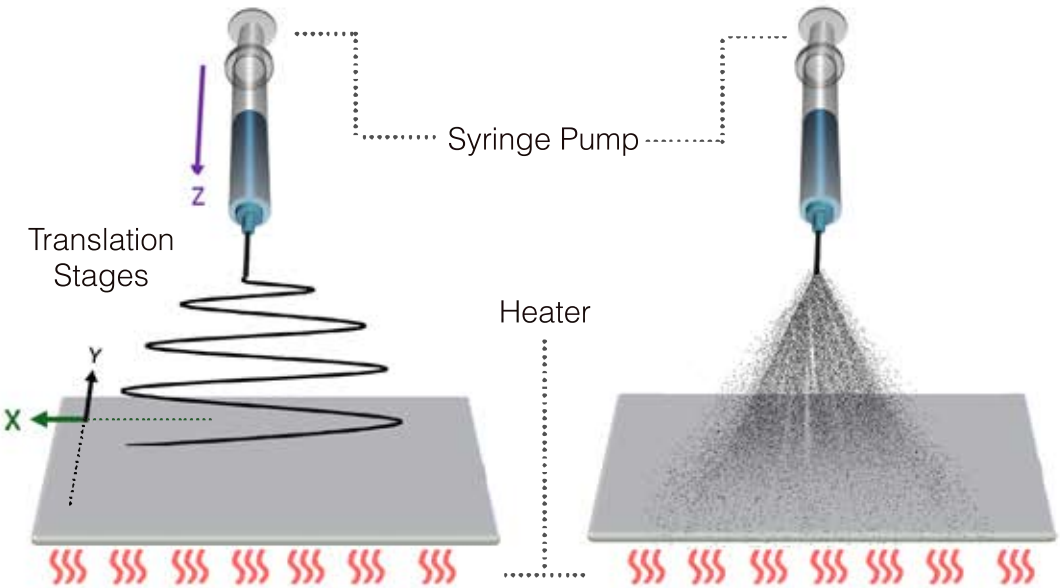
Electrospinning and Electrospraying System

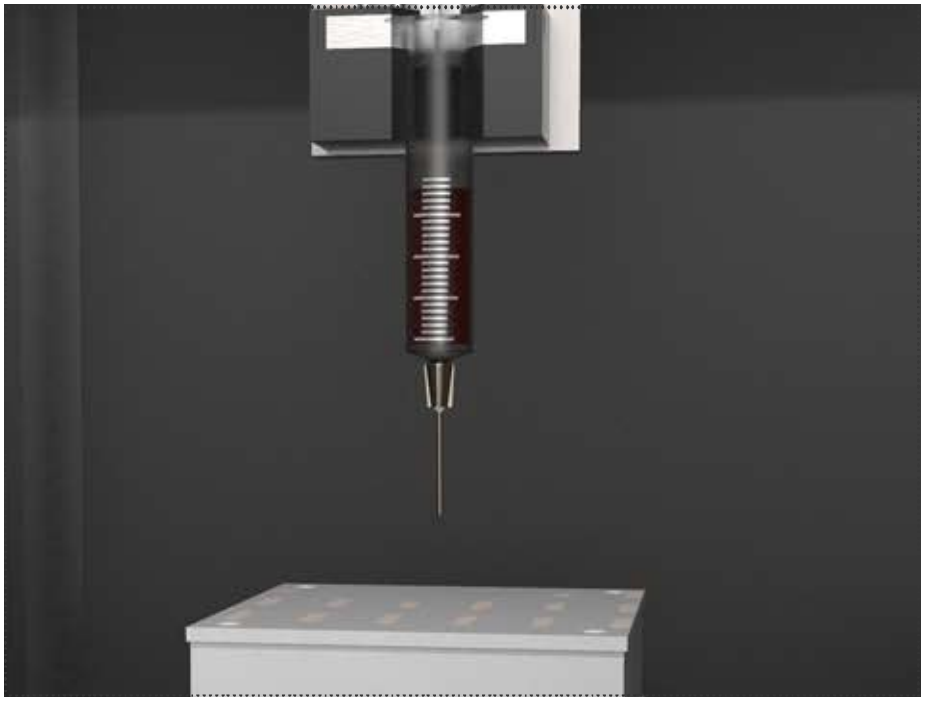
Qosain Scientific's electrodeposition unit allows the possibility of creation of novel morphological structures of various polymers on a wide variety of substrates and matrices. These polymers are driven by an intense electric field achieved by a high voltage supply. The polymeric solution is slowly discharged from a needle with the help of a pump that ejects the solution out of a syringe. The polymer can effuse in the form of a jet (electrospinning) or spray (electrospraying) depending on the voltage, distance between the electrodes and the properties of the solution.

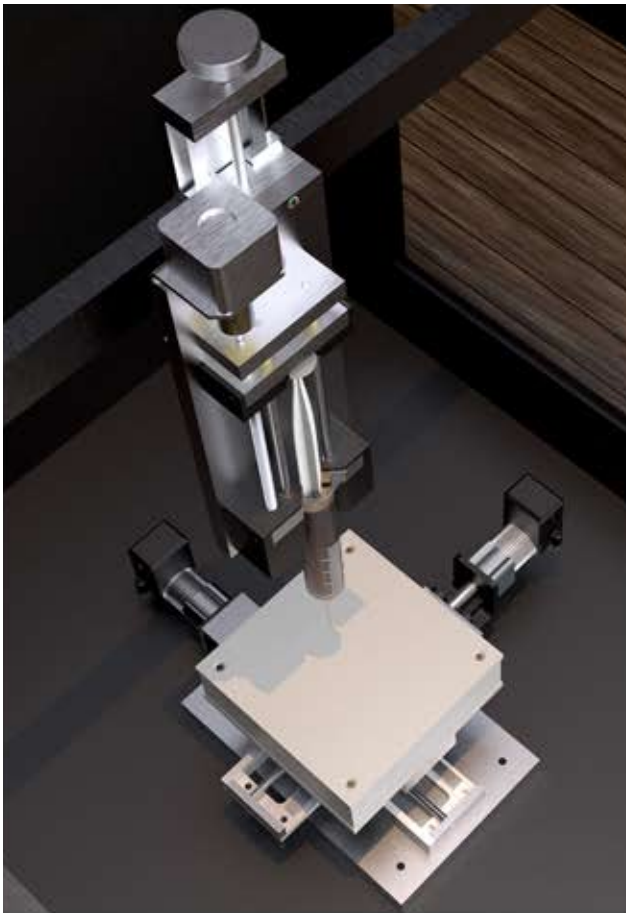


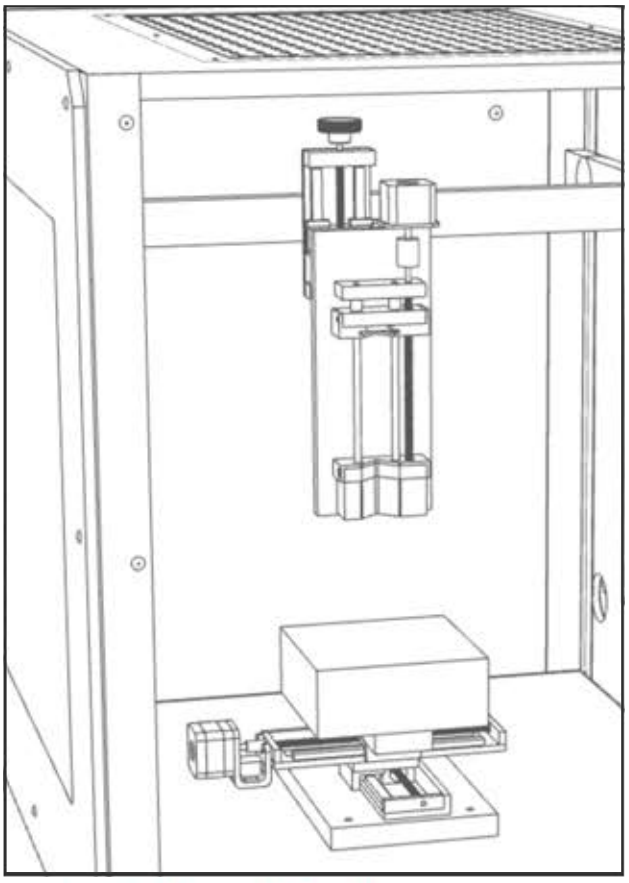












The substrate can be heated in-situ while the polymer is deposited. It can also reach different regions of the substrate by mounting the latter on translation stages which allow horizontal movement. The vertical distance between the tip of the needle and the syringe can also be adjusted.

Scientific and technological objectives

- Possibility of creating core-shell and sheathed fibers and polymer-matrix composites
- Controllable porosity, mechanical advantage of electrospun fibers
- Fabrication of random and oriented polymeric fibres
- Nanostructure design and production

Key advantages of electrospun and electrosprayed morphologies

- Interconnected fibrous structure with large surface-to-volume ratio
- Nanoscale dimensions
- Controlled, delayed release of bioactive and chemically active reagents

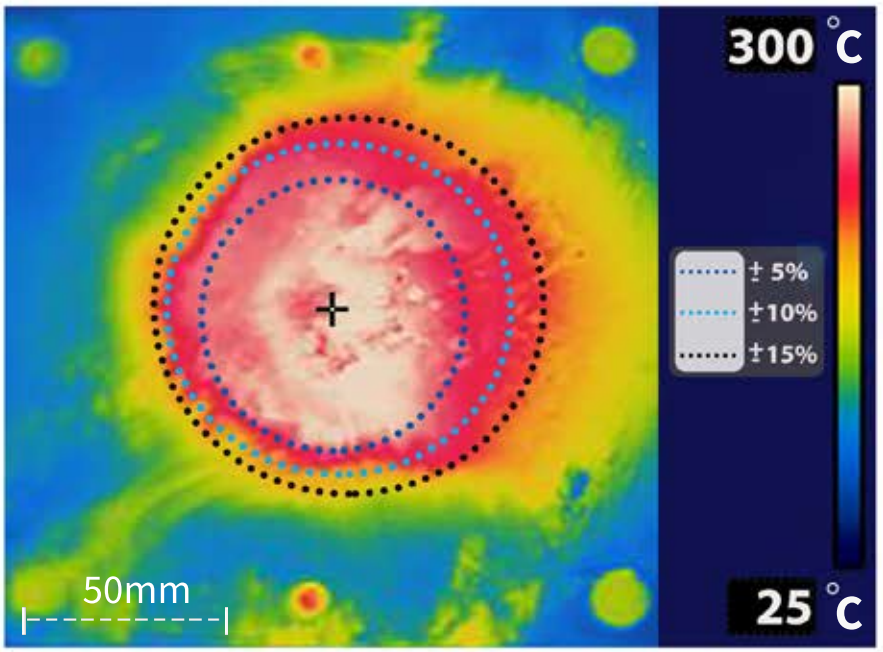
Selected applications areas

- Tissue engineering, wound healing, drug delivery platforms
- Energy storage, electronically active coatings
- Food preservation, coating, bio-activation
- Textile protection and texturing for anti-wash, fungicidal and pesticidal properties

Mechanism

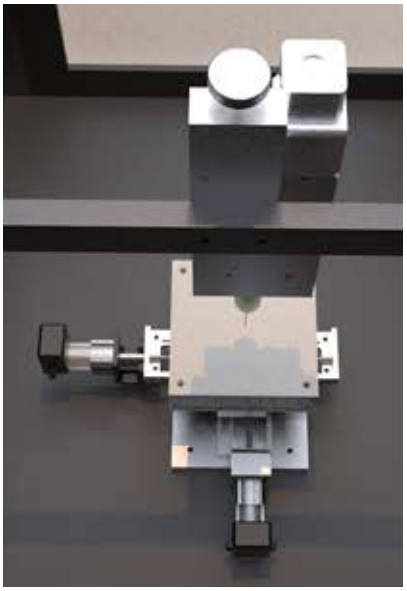
The apparatus has three main parts:

- A deposition chamber which contains a syringe pump mounted vertically and facing the bottom, a user detachable high-voltage connection and a hot plate mounted on a horizontally placed motorized planar stage. The substrate is placed on the heater. The heater can be switched off. The motorized stage allows movement of the heater in two perpendicular directions (say x and y). The distance between the syringe needle and the heater (called z) is manually adjusted and can be physically measured.

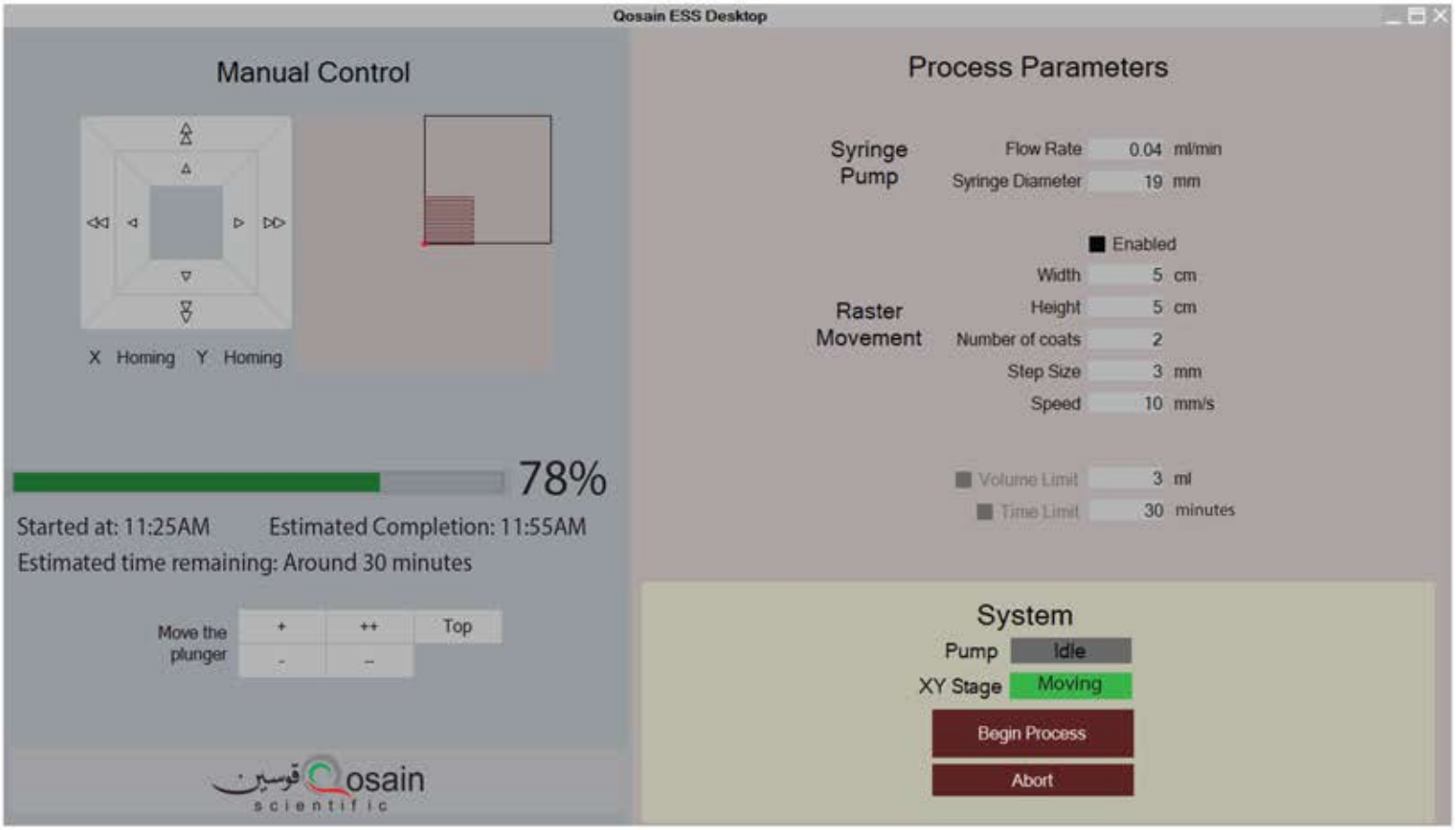


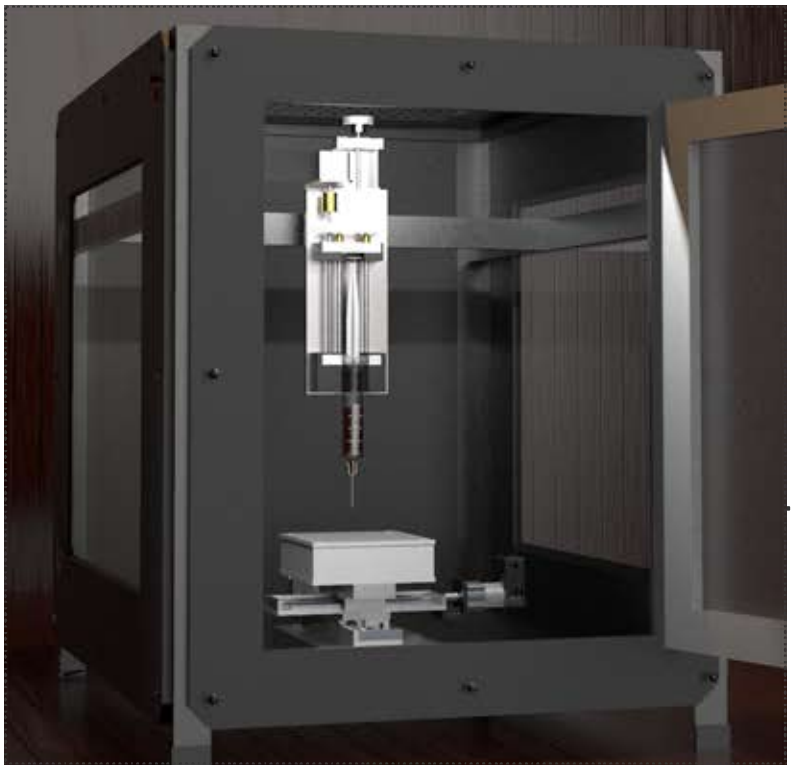
A thermal image of the hot plate showing the distribution of temperature

- A controller which includes mechanism for the (a) syringe pump, (b) lateral translation stages, (c) high voltage supply, (d) heater and temperature as well as the power buses to power up the unit. It also enables the user to control the HV supply, hot plate temperature and system power using adjustment knobs and power switches mounted on its front panel.



- A PC for interfacing between the various components. An interactive user interface that can be downloaded from the Qosain Scientific Cloud-based installer called the “Qosain Package Manager”, runs on the PC and provides a seamless interface with the machine. The software can be used to graphically monitor and control the movement of the syringe pump and the linear stages. The software allows us to customize many operation parameters like the shape of the raster pattern, movement speeds, working area and pumping capacity and intensity.





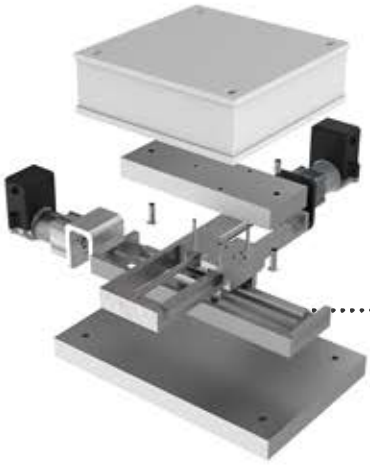
TYPES : mL

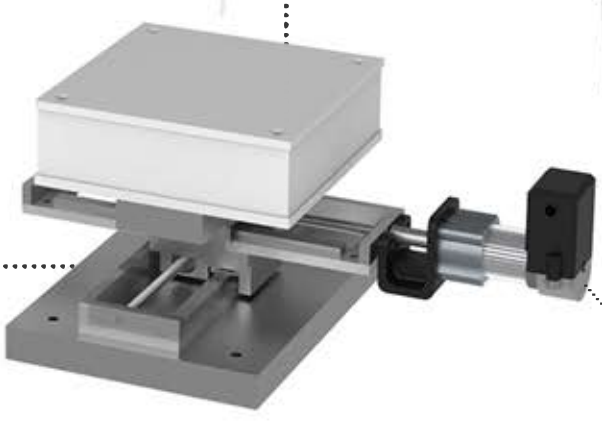
5

10

20

30





Stepper motor

Overview of use

To synthesize fibers or spraying the substrate with the polymeric material, a syringe, filled with the required material, is installed in the syringe pump. The properties of this solution such as viscosity, concentration are chosen by the researcher. The metallic needle of the syringe is connected with the high voltage connection and the target sample is placed on the hot plate. After adjusting the voltage and temperature on the front panel of the controller, the pumping and stage movement parameters are set on the computer screen. A “begin coating” button on the UI then starts the automatic fiber generation or electrospraying process.

Output voltage

0-30 kV

Output power

20 W

Syringe pump

Accepted syringes (standard)
5 ml, 10ml, 20ml, 30ml

Translation stages

Range:
X: 0-130 mm
Y: 0-130 mm
Z: 0-70 mm

Simple step size:
Small step: (1.00 ± 0.01) mm
Big step: (10.00 ± 0.01) mm

Raster parameters
Resolution: (0.010 ± 0.005) mm

Heater control

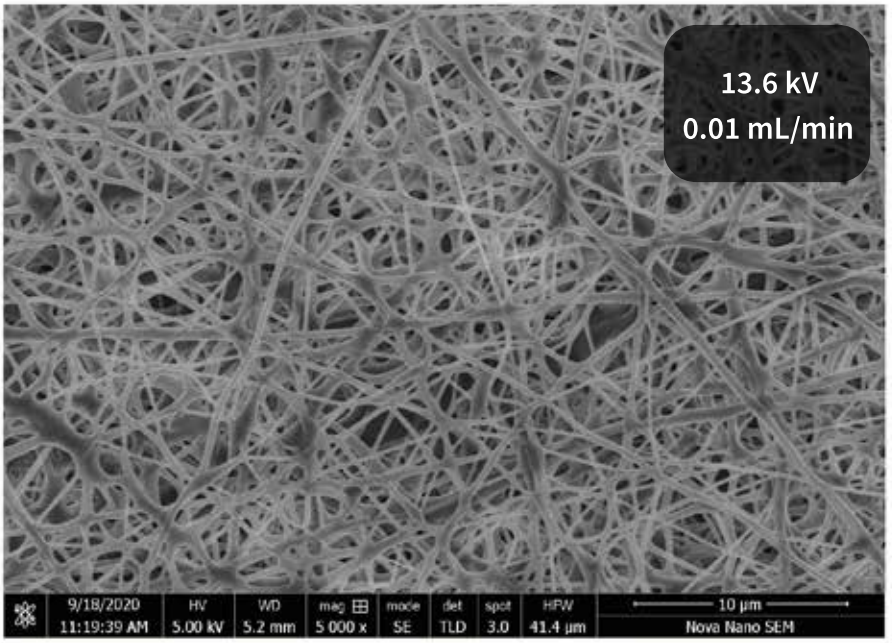
Temperature Range: 50-400°C
Control Type: PID
Measurement resolution: 1°C
Measurement sensor
K-type Thermocouple

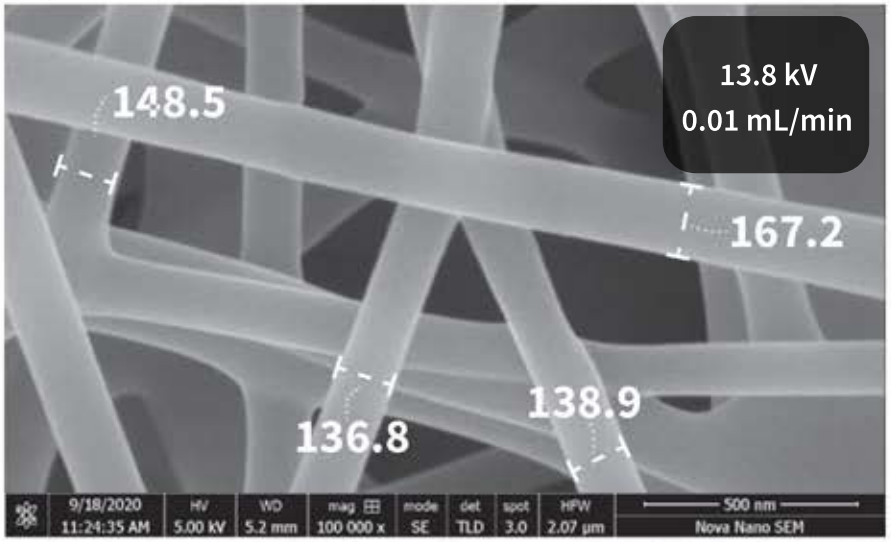
Power requirement

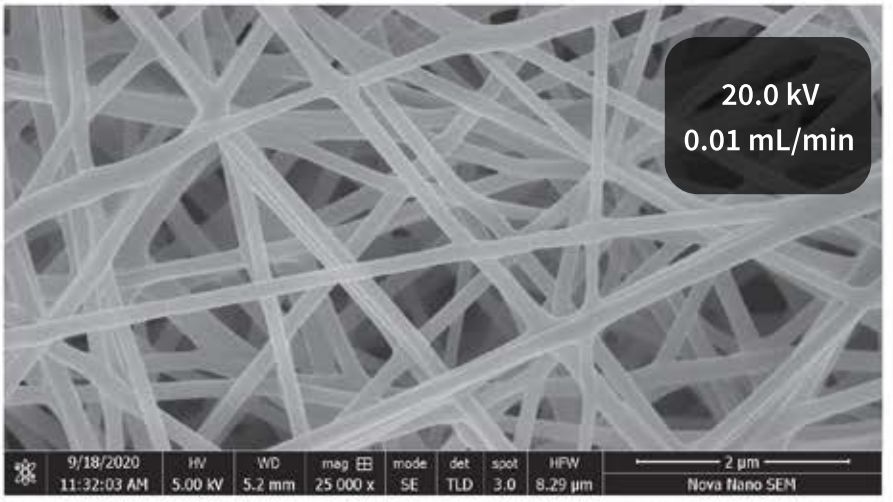
220-240 V / 450W (AC)

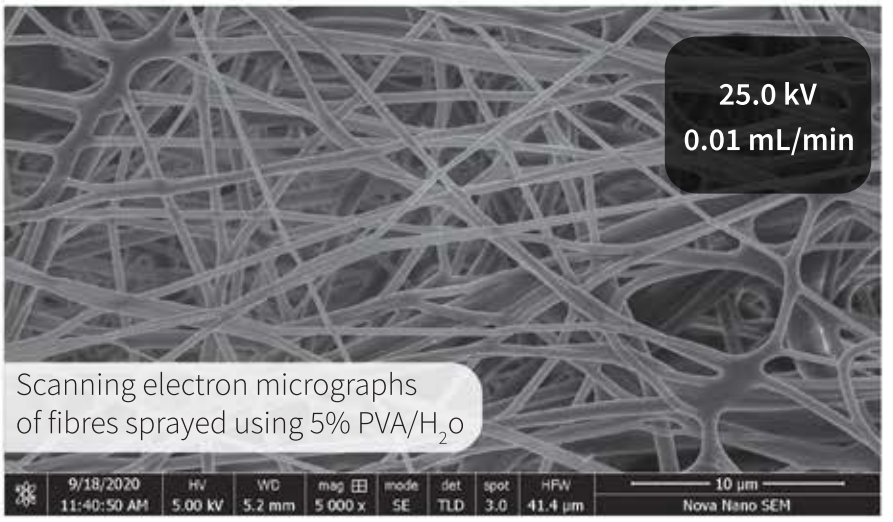
Safety features

Separate power switches
High Voltage emergency stop button
High Voltage fuse (3A)
Main system fuse (3A)
Earthed body









Scanning electron micrographs of fibres sprayed using 5% PVA/H_2O