

Coaxial Electrospinning & Electrospray

Professional Lab Device CC



Doxa Microfluidics offers a wide variety of Coaxial Electrospinning and Electrospray Lab Equipment for the design and production of Core-Shell, hollow and plain nanofibers and particles. All the lab equipment supplied by Doxa allows clean operation with both Coaxial electrospinning and electrospray technique and are built on demand to meet customer requirements and needs. For those scientists and engineers who devote to perform product design and mid-scale (lab scale) production of nanofibers and nanoparticles via Coaxial Electrospinning and Electrospray tech, and that need to control temperature and/or relative humidity, Doxa will deliver the right device to satisfy their needs. Focusing on this market niche Doxa has designed the Professional Lab Device V2.0: climate control (hereinafter Professional CC).



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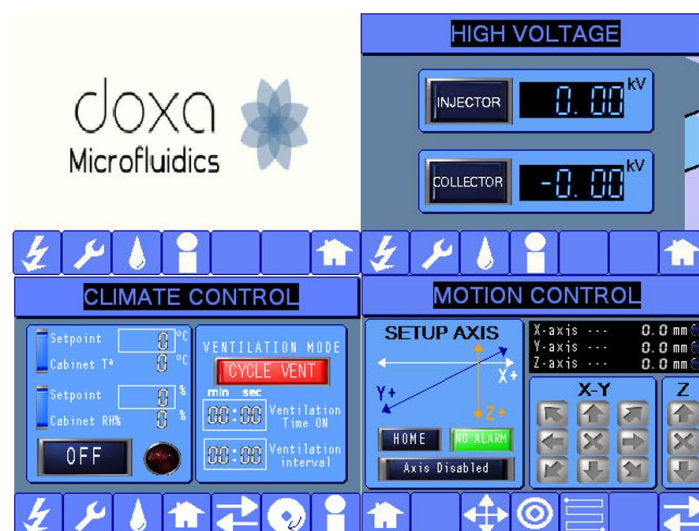
Professional Lab Device CC | FEATURES

- ✿ **Made of Aluminium, Stainless Steel and Climalit:** the unit has been designed to work in a laboratory and research environment; having an excellent flexibility, ease of use and minimum setup time and maintenance. The transparent and sealed doors located at the front allow the visualization of the process and facilitate the access to the cabinet. The climalit windows and the insulating elements help the equipment to keep cabin's temperature and relative humidity conditions. The unit is equipped with all security measures, ensuring a safe operation to the user. Professional CC has two operation modes: safe and expert. In safe mode the high voltage will turn off, and the movable parts will stop at the time the doors are opened to ensure the security of the user. In expert mode, although the doors are opened all the parts will keep in operation. However, the user will be warned about the risk by a flashing red beacon and warning messages in the touch screen. It also has an emergency stop button and a smoke detector that automatically shut down the equipment in case of risk.

- ✿ **A flat plate collector:** Stainless Steel (400 mm x 500 mm) isolated by DELRIN® tower is included.



- ✿ **Control digital panel:** a 5.7" sliding touch screen, located at the front panel, allows the user to control all the features provided by the equipment. The software includes a user-friendly interface with the option of programming a sleep mode (countdown to stop automatically all motions and high voltage).



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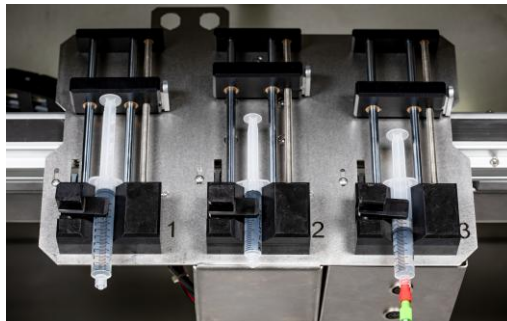
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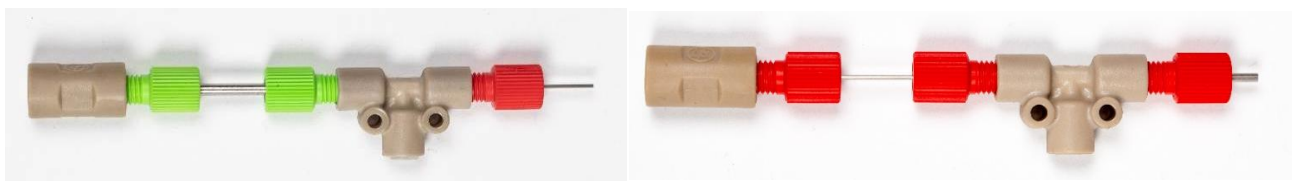
- Two High Voltage Power Supplies: reaching up to 60.000 V of voltage drop from the nozzle to the collector. Professional v2.0 is equipped with two power supplies: one positive (up to +30kV) and one with negative polarity (up to -30 kV) that reduces losses of material. The voltages are fully controlled from two knobs located at the front panel that allow the user a more accurate control of the process.



- Pumping system: two syringe pumps base liquid infusion system enable to use the **Coaxial Electrospinning and Electrospray tech**. Pumps are driven by stepper motors, allowing a high-resolution control of the flow rate through the nozzle. Syringes from 1 mL to 60 mL can be used. Flow rate can be varied from 7.8 $\mu\text{L/h}$ to 1692 mL/h depending on the syringe diameter size and brand. Pumping system is controlled from touch screen.



- Injectors and tubing of different diameter sizes. Single and Coaxial nozzle injector are supplied to operate in simple or coaxial mode respectively. The nozzle position (from the tip of the needle to the collector surface) is completely adjustable. Different needle diameter sizes are available. Consult our team to select the proper needle for your Project.



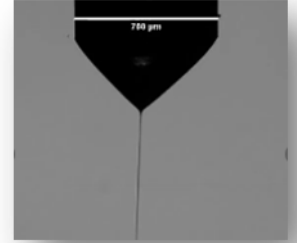
Single nozzle injector (left) and Coaxial nozzle injector (right).

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- ✿ **Taylor Cone Visualization System:** it is formed by a CMOS USB colour camera connected to a proper lens array that allows visualizing the Taylor Cone anchored at the tip of the nozzle. Professional v2.0 is provided with a USB output to connect the equipment to any computer, where the software (provided with the device) allows its visualization. Since an accurate control on the whole process is essential for the robust and reliable generation of nanofibers and particles, we consider this item indispensable.



- ✿ **Climate Control Unit:** external system that allows the user to accurately control the temperature and relative humidity (RH) inside the cabinet. Temperature can be modified from room temperature up to 45°C ($\pm 1^\circ\text{C}$), and RH can be modified from 10% up to 85% ($\pm 5\%$), both depending on room conditions. Compressed air is required to feed this system (feeding pressure of 7 bar) and tap water for RH (1-6 bar). System is controlled through the sliding touch screen located at the front part of the equipment. Can be preinstalled (only structural parts and the climate control elements will be installed in the future in user's facilities) or ordered from the beginning.
- ✿ **Integrated extractor hood:** the equipment includes an exhaust fan that allows an efficient ventilation of the cabinet to remove chemical vapours from it to the lab extraction system.
- ✿ **Warranty and after sales service:** one year from the delivery date. Doxa commits to reply in 48 working hours following the reception of notice (by email or phone) of requirement for repair or technical assistance from the user.
- ✿ **Installation and training course:** if the customer needs it, Doxa's personnel may travel to customer's facilities to complete the equipment installation and give a training course to show the end-user how the equipment works. During the training some electrospinning and electrospray experiments would be performed. In addition, Doxa also offers a full training

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course (2 days long) where the fundamentals basics of electrospinning and electropray techniques and the application of the Coaxial technique of microencapsulation will be performed.

- ✳ **Temperature and relative humidity sensors** are supplied with the equipment so the researcher can check temperature and RH inside the cabinet during the experiments.
- ✳ **User guide:** the equipment is supplied with a complete user guide that can be consulted by the final user in case of need.



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Professional Lab Device CC | TECHNICAL CHARACTERISTICS

GENERAL	
CHASIS MATERIAL	Aluminum, painted iron, stainless steel, laminated glass (climalit)
Total weight	500kg
Dimensions (height x width x depth)	1960mm x 1061mm x 1061mm (from casters to chimney)
Power supply	230V; 50Hz (125VAC version is available in this model)
Power consumption (max)	< 3200 W
Maximum amperage	16A
Operation interface	PROFACE 5.7 inches
Installation	Standing on its casters with breaks or on its levelable legs
HIGH VOLTAGE	
Polarization	Double polarization (+ and -)
Voltage range	-30 kV to + 30 kV
Maximum power	15 W per HV power supply
Adjustment voltage	Potentiometers 1,5 kV/ rev
SYRINGE PUMP	
Number of units	2
Syringe size that can be used	1 mL to 60 mL
Flow rate per syringe	From 7.8µL/h up to 1692mL/h depending on syringe diameter size
INJECTORS	
Type	One nozzle injectors: Single injector (ref: DMF-S06). Coaxial injector (ref: DMF-C02).
Diameter of needles DMF-S06 DMF-C02	OD/ID: 0.9/ 0.6 mm; L: 40mm Outer: 1.7mm/1.4mm (OD/ID)// Inner: 0.9mm/0.6mm (OD/ID).
Material of needles	Stainless Steel (AISI 304)
Material of body	PEEK
Distance injector – flat collector	50mm-300 mm
Distance injector- collector adjustment method	Manual or touch screen
COLLECTORS	
Type	Flat plane
Material	Stainless Steel
Dimensions	400mm x 500 mm
TAYLOR CONE VISUALIZATION SYSTEM	
Components	USB Camera, lens and rings (x40mm)
Resolution	744x480
Frame Rate at Full Resolution	76
Pixel Formats	8 bit bayer (GB)
Camera control	UVC/V4L2 (on Linux, via uvc-video) C Imaging Control (on Windows, via Device Driver for USB Cameras)

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Focus method	Manual
Position adjusted method	Manual or touch screen
Illumination	LED
SAFE AND SECURITY	
▪ Fume extraction unit. ▪ Emergency stop button. ▪ Automatic shutdown when opening a door.	▪ Red beacon to warn that high voltages are ON ▪ Protection to peaks of voltage and current. ▪ Smoke detector

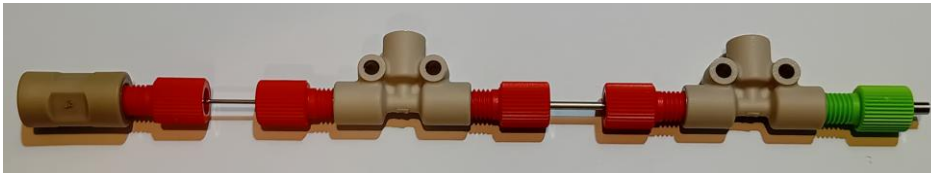
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Professional Lab Device CC | ACCESSORIES AND EXTENSIONS

- ✦ **Extension to Triaxial Mode:** addition of a third syringe pump driven by stepper motors allows a high-resolution control of the flow rate through the nozzles. This third pump enables the user to carry out the Triaxial Electrospinning technique. Syringes from 1 mL to 60 mL can be used, and the flow rate for this nozzle can also be adjusted between 7.8 μ mL/h to 1692mL/h. Triaxial nozzle injector included in this kit.



- ✦ **Heating System:** syringe, tube and needle heaters. Some polymers are soluble in certain solvents only at a given temperature, and precipitate if temperature is lower. For those cases, the Heating System will allow to keep the temperature of the solution during the experiment. Temperature can reach up to 100°C.



- ✦ **Multi-Nozzle Injectors:** can be used in Professional CC. Doxa designs and manufactures rounded single or coaxial multi-nozzle injectors with 10 or 20 needles and linear multi-nozzle injector with 3 or 5 needles. The functioning range and operating conditions of the multi-nozzle injector strongly depends on the liquid solution to be electrospun or electrosprayed. These accessories are meant to develop a scale-up process to adapt the one-nozzle experiments to multi-nozzle injectors with customer specific solution. For more information ask for Doxa team for Injectors TDS document.



Single multi-nozzle injector (left), Coaxial nozzle multi-nozzle injector (middle) and linear multi-nozzle injector (right)

- ✳ **Motion Platform:** Professional Lab Device CC can be equipped with 1D, 2D or 3D automatic electrical motion platform with adjustable speed that automatically drives sweeping of the nozzles. The speed and position control is commanded via touch screen of the equipment.

1D, 2D and 3D options		
Axis	Direction of the movement	Stroke
X	From left to right	400mm
Y	From back wall to front	400mm
Z	Up and down (to bring it closer or away from the collector)	50mm-220mm

- ✳ **Rotating Collectors:** Doxa offers several types of rotating collectors: disc, drum, patterned drum, mandrel, etc. The sense of rotation and the rotation speed, that is finely adjusted from 100 rpm up to 2000 rpm, are commanded via touch screen of the equipment. These rotating elements are designed according to our experience in the lab to improve the collection of nanofibers and preventing them from “flying out” from the collector. The collectors are safely connected to the negative high voltage wire. All the collectors supplied by Doxa can be interchangeable using because they use the same supporting base. For more information, ask our team for the Collector Datasheet document.

- ✳ **UV-C sterilizing light:** if your research requires sterilized samples a UV-C lamp can be installed in equipment that can be controlled from the touch screen. All the windows of Professional CC will be equipped with glass reinforced with Polycarbonate to prevent the UV-C radiation going out the cabinet. This lamp has a mixture of visible light to know if it is turned on. The user must be wearing PPE prepared for UV-C when using this element.



- ✳ **UV-Vis curing lamp:** this lamp is used to cure the polymeric sample that is being deposited on the surface of the rotating collector. This lamp is commanded from the touch screen of the equipment. All the windows of Professional CC will be equipped with glass reinforced with Polycarbonate to prevent the UV-C radiation going out the cabinet. This lamp has a mixture of visible light to know if it is turned on. The user must be wearing PPE prepared for UV-C when using this element. Covers for feeding tubes and needle are available to prevent the polymer to cure before it is electrospun.

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- ❁ **Gas Jacket:** this system allows the user to prevent the Taylor cone from drying out by carrying the solvent of the polymeric solution in vapour form to the tip of the coaxial nozzle injector. Compressed air or nitrogen is needed to carry the solvent in vapour form to the nozzle injector.



Professional Lab Device CC | FULL CUSTOMIZATION

- ❁ Doxa can design, manufacture and add new features to your equipment that are not described in this document. If any of the described accessories or limits (stroke, flow rate, speed, etc) do not fit with your research, you can contact Doxa team to customize the equipment to meet your research goals. We are experts in customization to help our customers to meet their goals.