NANOFIBER
ELECTROSPINNING
SYSTEMS

MECC CO., LTD.

Total System Catalog September 2019

Electrospinning Method

Major features of the electrospinning method is to spin a variety of materials (mainly polymers) into nanofiber shapes and control of fiber shapes is relatively easy.
Research up to now realized electrospinning of the following materials.
(See Fig.1)

- *Industrial thermoplastic polymer*
- *Biodegradable polymer*
- *Polymer blend*
- *Composite materials mixed with inorganic compounds*

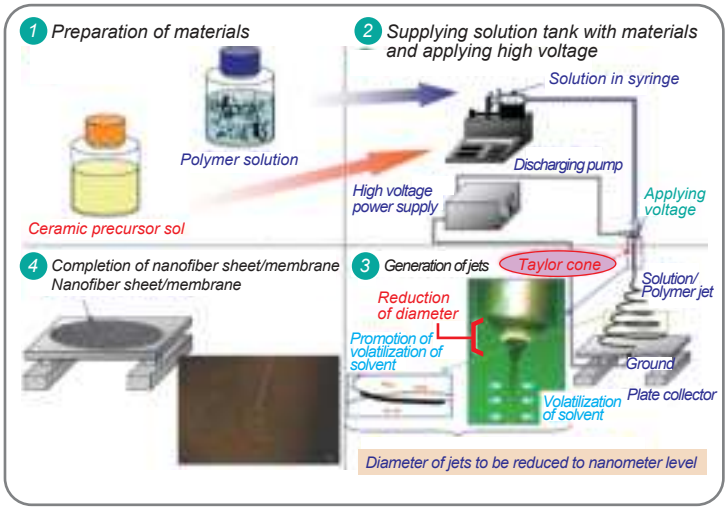


Fig. 1 Principles of electrospinning

In recent years spinning cases of the ceramic nanofibers such as Alumina, Zirconium oxide, Titanium oxide and Lead zirconate titanate are reported frequently.
Electrospinning method usually uses solutions in which materials dissolve in solvents as spinning materials.Electrospinning system, as shown in Fig. 1, consists of a high voltage power supply, polymer solutions, a storage tank, a spinneret and a grounded collector. Polymer solutions will be pushed out of a tank to a spinneret at a constant speed.

High voltage at 20kV to 40kV will be applied to a spinneret and polymer solution jet will be injected to a collector when electrical attraction exceeds surface tension of polymer solutions. Solvents in jets are gradually volatilized and jets will reduce to nanometer level when they reach a collector.

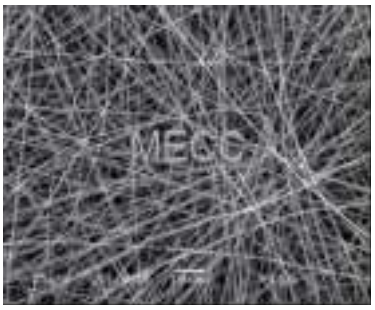
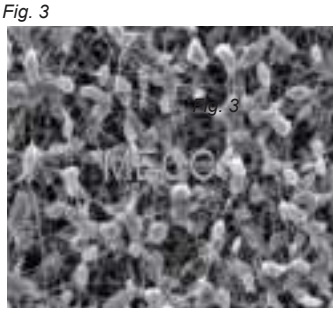


Fig. 2

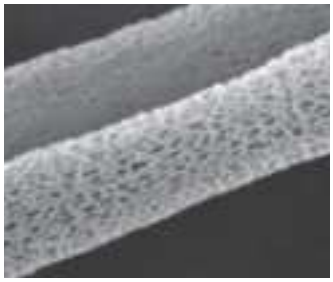
Electrospun nanofibers forms membranes shown in Fig. 2. Orientations of fibers depend on a collector.
Nanofiber membranes are known that its total surface area per volume is much more than that of micrometer-size fiber membranes.

Fig. 3



Beaded fiber

Aligned fiber



Porous fiber

Nanoflament

As a result, nanofibers obtain unprecedented characteristics by having chemical or physical modifications, and new applications in various fields are expected.

As shown in Fig. 3, even if the same polymer is spun, fibers in different shapes, such as smooth-surface fibers, beaded fibers and porous fibers can be made by changing spinning parameters.
Parameters in terms of electrospinning are generally divided into three groups of solution characteristics, spinning environment and spinning conditions. (Fig. 4)

Solution Characteristics
- Solution concentration
- Viscocity
- Conductivity
- Elasticity
- Surface tension

Spinning Environment
- Ambience temperature
- Humidity
- Barometric pressure

Spinning Conditions
- High voltage output
- Feed rate of solutions
- Distance between collector and spinneret
- Winding speed of a collector

Fig. 4 Parameters of electrospinning method to influence shapes of nanofibers

How to combine such parameters is "knowhow."
It is most difficult to find out the best spinning conditions to obtain desired shape of nanofibers, which usually takes a long time period.

So much time has been taken by many people to figure out relevancy between such parameters and shapes of fibers, however, it is becoming clearer in these days.

Polymer concentration of spinning solutions is obviously the most important factor to control diameters of polymer fibers. Also, design of a collector will be important to control orientation of fibers.

Aligned nanofiber samples made with a disk collector is shown in Fig. 5. There are several important parameters to be controlled such as fiber diameters, surface shapes and orientations.

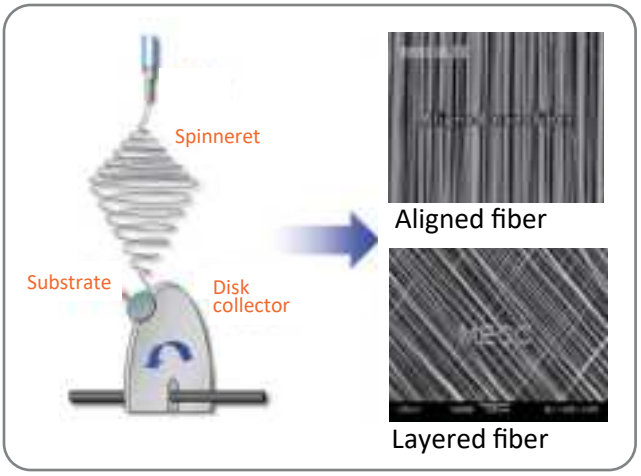


Fig. 5

Applications of Nanofibers

Applications of nanofibers below are currently thought to be promising, and research in such fields is progressing at many colleges, laboratories and corporations.

- **Environmental engineering**
  Water filter, dust filter, face mask
- **Functional goods**
  Functional clothes, functional food
- **Electronic materials**
  Battery separators, high conductivity materials, transparent conductive film
- **Medical/Health care, Biology**
  Regenerative medicine, wound treatment, drug delivery system, cell culturing, blood vessel

Environmental engineering

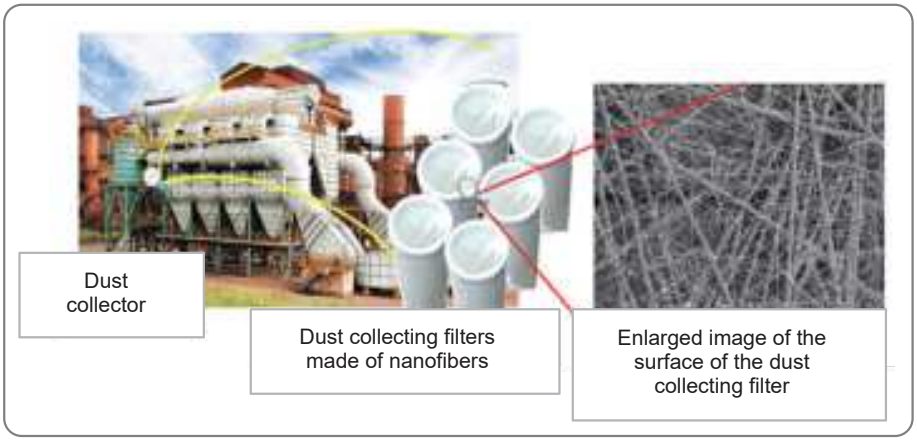
In the field of environmental engineering nanofibers are well known with products such as filters or face masks.

Targeted molecules can be eliminated at high efficiency with water processing filters made of nanofibers making use of their high performance filtering.

Also, face masks which can capture very small particles such as PM2.5 with a nanofiber layer are being globally developed to protect people from serious air pollution.

N95 nanofiber mask developed by NAMI

As one of the applications filters to eliminate cesium are under development.
Extremely small particles of cesium, which were not collected only with meltblown nonwovens, can be collected by integrating nanofiber non-woven layers to meltblown nonwovens.
(From the patent publication list)



Structure of dust collectors and filters (from the website of NEDO)

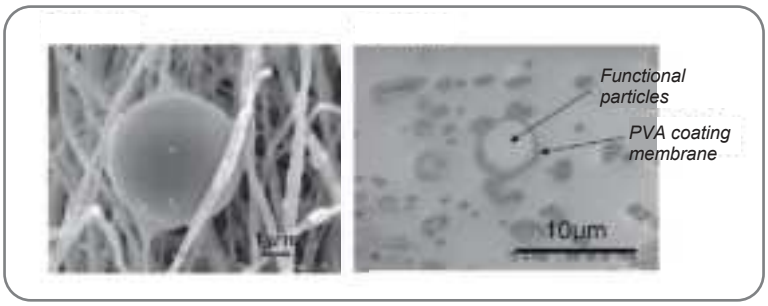
Functional goods

In recent years some research results report that a variety of textiles can be spun using not only a single and simple nanofiber but also composite materials of textiles, composite materials with particles or coating materials of functional objects.

A cooperative team of University of Lincoln in England and Iranian Food Science and Technology Research contributed a total analysis of electrospinning method suitable for food applications in an academic journal "Food Hydrocolloids" .

Dr. Nick Tucker of University of Lincoln, one of the authors explains that the electrospinning method helps new supplementary food compound be produced, and design and performance of delivery system be progressed in this article. That is, nanofibers spun with the electrospinning method are expected to be used for food delivery system to protect nutrition between processing and storage or during transfer to another location inside a body.

Sports wear with a nanofiber layer of high breathability and waterproof performance

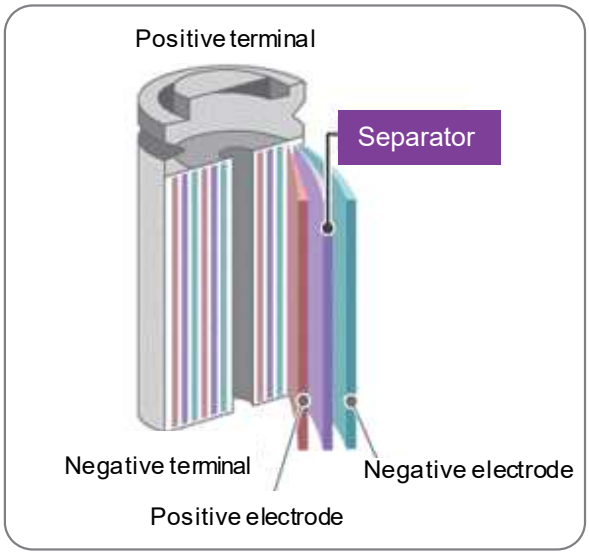


Nanofiber nonwovens containing functional particles (from the patent publication list)

Electronic materials

In the field of electronic materials nanofibers are expected for applications such as:

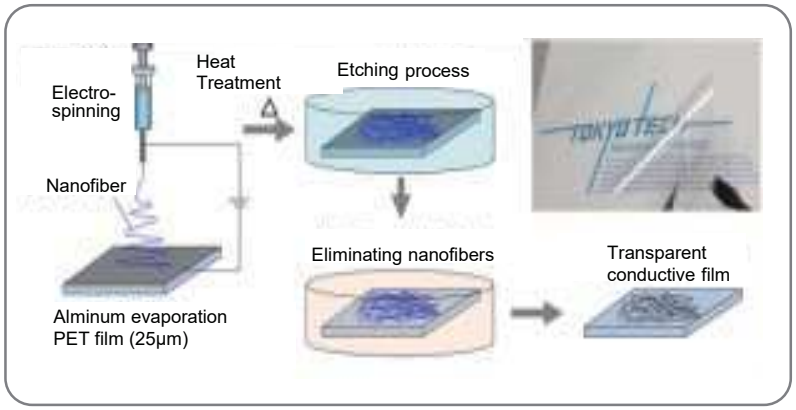
- Electrodes or separators for high efficiency solar batteries, fuel cells, and secondary batteries.
- Transparent conductive filters (electrodes) for displays, touch panels and functional glass.



Separators in a battery (from the website of Teijin Corporation)

The group of Associate Professor Matsumoto at Tokyo Institute of Technology is developing transparent conductive films, which are expected to be replacements for ITO that is currently used for electrodes and display panels.

Those films feature that they have as high visible light transmission rate as that of ITO at 80% and high conductivity at 45Ω/sq of surface resistance, and they are very thin, light, flexible and unbreakable.



Transparent conductive film (from the website of Tokyo Institute of Technology)

Medical/Health care, Biology

Medical/health care or biology is one of important applications of nanofibers made with electrospinning method and is attracting researchers' interests. Some of products related to regenerative medicine are already commercialized overseas.

Japanese ministry of economy and industry reports that the market size of goods related to regenerative medicine is presumed to be USD 150billion worldwide and USD13billion in Japan in 2050.
Also, it presumes that sales of medical materials such as culture mediums and scaffolds, which mostly employs nanofibers, will be USD 34.7 billion worldwide in 2050.
That shows use of nanofibers in medical area will be rapidly and widely expanded in the future.

Market size related to regenerative medicine

	JAPAN	World
2012	170	2,400
2020	950	11,00
2030	5,500	52,000
2050	13,000	150,000

(Million USD, JPY100/USD)

Market size related to culture mediums, serums and reagents (including scaffolds)

	JAPAN	World
2012	40	545
2020	148	1,815
2030	969	11,610
2050	2,300	34,664

(Million USD, JPY100/USD)

Features of nanofibers from a medical viewpoint

1) Adhesiveness to cells

Easy to use as scaffolds of cells.

2) Bioabsorbability and biodegradability

To be absorbed or degraded in a body for a certain period.

3) Porosity and wide surface area

- Many spaces where solutions will permeate.
- High preservation of water.
- Easy to influence contacting biotissue

4) Adjustable strength

Strength and elasticity is adjustable.

Emergency dialysis membrane (from the website of NIMS)

Typical applications in medical area

Applications in practical use are increasing year by year.

- ***Assistance of human body's functions***

  Artificial blood vessel, artificial cornea, artificial skin, covered stent
  Prosthetic agent for artificial bones

- ***Drug releasing/Drug delivery (DDS)***

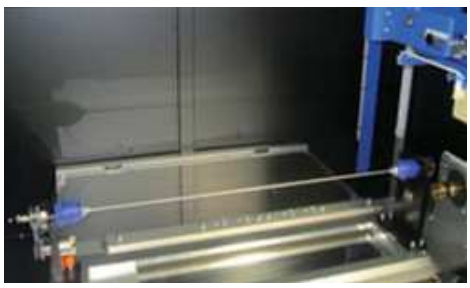
  Drug releasing capsule, percutaneous absorption agent

- ***Wound/disease treatment /***

  Transdermal patch to nerves / organs, surgical dressings
  Adhesive bandage, dialysis membrane, adhesion preventive agent

- ***Cell culturing/Scaffolds for cell multiplication***

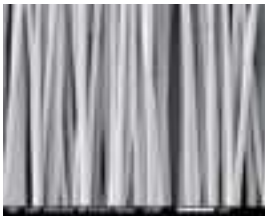
  Scaffold materials for regenerative medicine
  Culturing and separation of cells



Electrospinning of tube fibers for artificial blood vessels with a special mandrel collector

Tube fiber for covered stent (made by MECC)

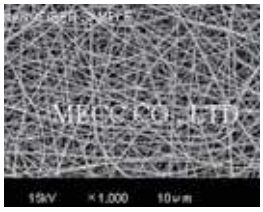
Tube fiber for artificial blood vessel (made by MECC)



Aligned nanofiber sheets for scaffolds to culture cells

Electrospinning Equipment

Here is a lineup of electrospinning equipment for laboratory use and pilot production.
Specially-designed spinnerets (nozzles) and collectors are available to be integrated to such systems for special applications as required.
Please consult our sales representative or research staff to choose adequate combinations of devices.
Also, we are willing to make nanofiber samples at our laboratory before introducing electrospinning equipment.



● For laboratory use

- ■ NANON-01A — Worldwide best-selling equipment to electrospin a variety of nanofibers.
- ■ NEX-101 — An entry model for experiments and to find spinning conditions.
- ■ NF-103 — A lab-use model of which functions were expanded from the NANON-01A.
- ■ NF-500 — A high-end model integrating a high voltage supply up to 50kV.

● For pilot production

- ■ NW-103 — A system to spin nonwovens and core/shell nanofiber sheets. Effective spinning width at 850mm.
- ■ NF-1001 — A high-efficiency system to spin nonwovens and core/shell nanofiber sheets. Effective spinning width at 1000mm.

NANON-01A
Electrospinning System for R&D

The model NANON-01A is a nanofiber electrospinning system for lab use. A variety of materials can be easily spun by programming spinning conditions and combining system parts such as spinnerets and collectors.

The system has been supported by many researchers of nanofibers all over the world due to its operability and reliability. The system will save much time and cost for making samples and for developing products.

● Spinning high quality nanofiber sheets
Unique technology of MECC creates stable electric fields to spin nanofibers of uniform and thin fiber diameters.

● A turn-key system to spin nanofibers
All component devices necessary to spin nanofibers such as a high voltage supply, a syringe pump, a spinneret, a collector and a conttrol panel are integrated to the standard system.

● A variety of nanofibers to spin
With combination of spinnerets and collectors the device can make many types of nanofibers such as aligned fibers and core/shell sheets.

● Thinking about operators' safety
The NANON-01A has safety features such as a high voltage interlock, a door lock during operation and instant high voltage shutoff and a signal tower thinking about operators' safety.

● Cleaning mechanism
A programmable cleaning device is integrated to the system to clean a tip of a needle automatically.

【Standard parts】

Parts	Model	Part number
Collector	Plate collector	C-PL

Parts	Model	Part number
Spinneret	Clip Spinneret_75	S-CL/75

【Optional parts】

Parts	Model	Part number
Collector	Drum Collector_φ200W200	C-DR/D200W200
	Drum Collector_φ100W200	C-DR/D100W200
	Drum Collector_φ200W30	C-DR/D200W30
	Disk Collector	C-DI
	Mandrel Collector	C-MA/200
	Y-axis slide collector	C-YA
	R to R collector	C-RR/200

Parts	Model	Part number
Spinneret	Tubeless spinneret	S-TU/75
	Coaxial spinneret 18G	S-CA/18G/75
	Coaxial spinneret 22G	S-CA/22G/75
	Coaxial spinneret 27G	S-CA/27G/75
	Multi-jet spinneret 4-holes	S-MJ/4S
	Vertical clip spinneret	S-VCL/75
Pump	Syringe pump	YSP-101

NEX-101

Nanofiber Electrospinner for Experiments

The model NEX-101 is an entry model for nanofiber electrospinning and is suitable for experiments to make samples and to find and set spinning conditions.

The system integrates devices necessary to spin nanofibers such as a high voltage supply, a spinneret, a collector and a syringe pump.

- **Easy setting of spinning conditions**
  Following conditions can be easily set.
  - High voltage: 0 to 30kV
  - Spinning distance: 100 to 200mm
  - Traversing distance: 0 to 200mm
- **Controllers on the front panel**
  All controllers and a display are on the front panel for easy operation.
- **Safety for operators**
  Thinking about operators's safety a metallic chassis, a high voltage lamp and an emergency stop switch are equipped with the system.
- **Quick and easy spinning of nonwovens**
  Using a traversing spinneret and a drum collectoor 150mm x 150mm nonwovens sample can be obtained quickly and easily.

Standard parts

Parts	Model	Model number
Collector	Drum collector	-
Pump	Syringe pump	YSP-10

Parts	Model	Model number
Spinneret	Clip Spinneret	-

NF-500

Electrospinning System for R & D

The model NF-500 is a high-end-model electrospinning equipment for lab use. By integrating component units such as a 50kV high voltage power supply, a multi-jet spinneret and a roll-to-roll collector and a solution heating spinneret, it can spin a variety of nanofibers.
**A special model for medical use is also available. Please consult our sales representative.*

- **Integrating a roll-to-roll collector**
  By the combination with multi-jet spinnerets it can spin 450mm-wide sheets of nanofibers continuously.
- **Spinning aligned fiber sheets**
  With a drum collector the system can spin aligned nanofiber sheets typically used for cell culturing or electronic devices.
- **Two built-in syringe pumps**
  The system can spin two different solutions at one time with two builtin pumps, which enables to create core/shell structure nanofibers.

Standard parts

Parts	Model	Model number
Collector	Plate collector	C-PL
Spinneret	Clip spinneret_100	S-CL/100

Parts	Model	Part number
Power supply	High voltage supply	HVU-50P100*

**Choose model HVU-50N100 for negative polarity.*

Optional parts

Parts	Model	Model number
Collector	Plate collector	C-PL/600x150
	Plate collector	C-PL/600x600
	Drum collector	C-DR/D200W200
	Drum collector	C-DR/D200W300
	Drum collector	C-DR/D200W30
	Disk collector	C-DI
	Mandrel collector	C-MA/600
	R to R collector	C-RR/450
	Y-axis slide collector	C-YA
Spinneret	Tubeless spinneret	S-TU/100
	Coaxial spinneret 18G	S-CA/18G/100
	Coaxial spinneret 22G	S-CA/22G/100

Parts	Model	Model number
Spinneret	Coaxial spinneret 27G	S-CA/27G/100
	Multi-jet spinneret 4-holes	S-MJ/4
	Multi-jet spinneret 6-holes	S-MJ/6
	Multi-jet spinneret 8-holes	S-MJ/8
	Multi-jet spinneret 12-holes	S-MJ/12
	Vertical clip spinneret	S-VCL/100
	11-syringel clip spinneret	S-11N/100
	Solution heating spinneret	S-HU-100
Pump	-10kV negative supply*	HVU-10N100
Power supply	Induction heating supply	IHP-101
Controller	Temperature controller	for IHP-101

**To be connected to a collector.*

NF-103

Electrospinning System for R & D

The model NF-103 is an electrospinning equipment for lab use and is recommendable to a user who looks for extensibility of performance and up-to-date spinning technology.

- **Spinning aligned sheets and core/shell fibers**
  The system can spin aligned sheets with a 200mm-wide and 200mm diameter drum collector and core/shell structure nanofibers with two built-in pumps and a coaxial spinneret.
- **Quick and easy programming**
  Spinning parameters and cleaning of needles can be easily programmed with a touch panel.

【Standard parts】

Parts	Model	Part number
Spinneret	Clip spinneret	S-CL/75
Collector	Plate collector	C-PL

Parts	Model	Part number
Power supply	High voltage supply	HVU-40P100*

*Chooose model HVU-40N100 for negative polarity.

【Optional parts】

Parts	Model	Part number
Collector	Drum collector	C-DR/D200W200
	Drum collector	C-DR/D100W200
	Drum collector	C-DR/D200W30
	Disk collector	C-DI
	Mandrel collector	C-MA/200
	R to R collector	C-RR/200
	Y-axis slide collector	C-YA
Spinneret	Tubeless spinneret	S-TU/100

Parts	Model	Part number
Spinneret	Coaxial spinneret 18G	S-CA/18G/75
	Coaxial spinneret 22G	S-CA/22G/75
	Coaxial spinneret 27G	S-CA/27G/75
	Multi-jet spinneret 4-holes	S-MJ/4
	Multi-jet spinneret 6-holes	S-MJ/6
	Multi-jet spinneret 8-holes	S-MJ/8
	Multi-jet spinneret 12-holes	S-MJ/12
	Vertical clip spinneret	S-VCL/100

Comparison of Functions ; Lab Equipment

Electrospinning equipment for lab use	 NEX-101	 NANON-01A	 NF-103	 NF-500
Typical objects	Nonwovens sheet (150mm x 150mm)	Nonwovens sheet (200mm x 600mm) Aligned sheet Core/shell fibers	Nonwovens sheet (200mm x 600mm) Aligned sheet Core/shell fibers	Nonwovens sheet (450mm-wide sheet) Aligned sheet Core/shell fibers
Standard collector	Drum	Plate	Plate	Plate
Optional collector	n/a	Drum φ200 w200 Disk Mandrel w200 RtoR w200 Y-axis slide	Drum w200 Disk Mandrel w200 RtoR w200	Plate 600 x 600 Drum φ200 w300 Disk Mandrel w600 RtoR w450
Standard spinneret	Clip (50mm-wide)	Clip (75mm-wide)	Clip (75mm-wide)	Clip (100mm-wide)
Optional spinneret	n/a	Vertical clip Tubeless Coaxial Multi-jet 4hole	Vertical clip Tubeless Coaxial Multi-jet 4 hole Solution heating	Vertical clip Tubeless Coaxial Multi-jet 4/6/8/12 hole Solution heating 11-syringe
High voltage	30kV	30kV	40kV	50kV
Optional high voltage	n/a	n/a	n/a	-10kV
Syringe pump	YSP-101	1 built-in	2 built-in	2 built-in
Spinning distance	100 to 200mm	50 to 150mm	50 to 300mm	50 to 300mm
Traversing speed	20mm/sec	300mm/sec	300mm/sec	300mm/sec
Rotation speed	Drum 50rpm	Drum 150 to 3000rpm Disk 3000rpm Mandrel 50 to 100rpm	Drum 150 to 3000rpm Disk 3000rpm Mandrel 50 to 100rpm	Drum 150 to 3000rpm Disk 3000rpm Mandrel 50 to 100rpm
Control	Switches and knobs	10-key	Touch panel	Touch panel
Dimensions	750W x 500D x 880H (mm)	830W x 630D x 880H (mm)	1260W x 750D x 1910H (mm)	1460W x 950D x 2056H (mm)

NW-103

Nonwovens Spinning System for Pilot Production

The model NW-103 is a pilot production system to electrospin nanofiber nonwovens sheets with a roll-to-roll system.

With solutions such as PVDF, PAN and PVA the system makes nanofiber sheets of which fiber diameters are from several tens to hundreds of nanometers.

- **High speed production of 850mm-wide membranes**
  The NW-103 can spin nonwovens of 850mm effective width at the conveyor speed of 10 meter/min with multiple multi-jet spinnerets on 4 or 6 rows.
- **100µm or thicker membranes**
  Connection of a negative high voltage supply to the collector creates membranes of 100µm or thicker.
- **Use of 3 different solutions**
  The system integrates 3 gear pumps which can be controlled separately, enabling spinning of nanofiber sheets using 3 different solutions.

Multi-jet spinnerets

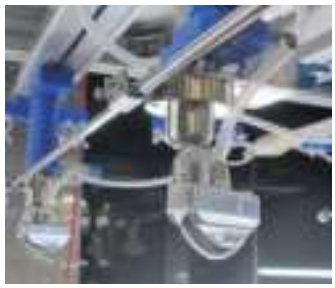
NF-1001

Electrospinning System for Pilot Production

The model NF-1001 is a pilot production system to electrospin nanofiber nonwovens sheets with a roll-to-roll system.

Membranes of effective width at 1meter can be spun effectively and uniformly.

- **100µm or thicker membranes**
  100µm or thicker membranes can be spun by use of +50kV and -30kV high voltage supplies.
- **Special multi-jet spinnerets for high productivity**
  State-of-the-art multi-jet spinnerets (MJS) be integrated on 6 rows (a maximum of 21 pcs) to spin wide and thick
- **Easy connection with an existing Roll-to-roll unit**
  An existing roll-to-roll unit can be easily connected to the NF-1001 by the input of sync signals from the system.
- **Programming on the touch panel**
  Spinning conditions can be quickly and easily programmed and memorized on the touch panel.



CFS-101

Core/Shell Nanofiber Production System

The model CFS-101 is an electrospinning equipment to spin core/shell structure nanofiber sheets for applications such as medical use or electronic devices.

- **Special coaxial spinnerets**
  3 - 12 coaxial spinnerets be integrated to electrospin core/shell structure nanofibers effectively.
- **Programming via touch panel**
  Spinning conditions can be quickly and easily programmed and memorized via touch panel.

Coaxial spinnerets

【Typical Spinning Data】

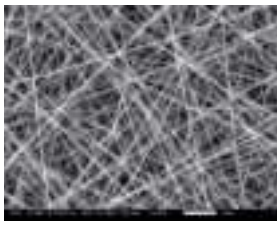
	Core materials	Shell materials	Weight/m²
1	Mineral oil	PVDF (15wt%)	4.2g/m²
2	PVA (10wt%)	ABS (19wt%)	2.7g/m²
3	PS (30wt%)	PVDF (15wt%)	2.1g/m²

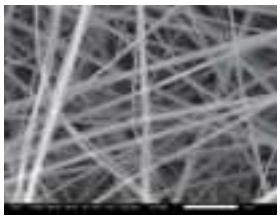
Number of nozzles: total of 14 pcs on 4 row

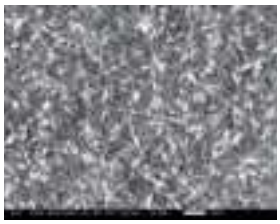
Comparison of Functions ; Pilot Production System

Electrospinning equipment for pilot production	 NW-103	 NF-1001
Typical objects	Nonwovens Effective width: 680mm Core/shell structure sheets	Nonwovens Effective width: 1,000mm or more
Standard collector	Steel belt	Steel belt
Optional collector	Roll-to-roll unit (600mm)	Roll-to-roll unit (1000mm)
Standard spinneret	Multi-jet spinneret (MJS)	Multi-jet spinneret (MJS)
Optional spinneret	n/a	n/a
High voltage supply	Positive +40kV (3 units) Negative -10kV (1 unit)	Positive +50kV (3 units) Negative -30kV (1 unit)
	Gear pump (3 units)	Gear pump (3 units)
Solution supply	50 to 500ml/hour	50 to 500ml/hour
Spinning distance	100 to 300mm	100 to 400mm
Traversing	Traversing range: 100mm (+/- 50mm) Traversing speed: 0 to 100mm/sec	Traversing range: 400mm (+/- 200mm) Traversing speed: 0 to 300mm/sec
Conveyor speed	10,000mm/min or less	15,000mm/min or less
Control/Programming	PLC / Touch panel	PLC / Touch panel
Dimensions	2,038W x 1,285D x 2,170H mm	3,153W x 2,412D x 2,643H mm

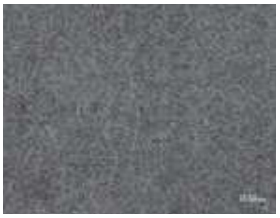
Nanofiber Sample Photos

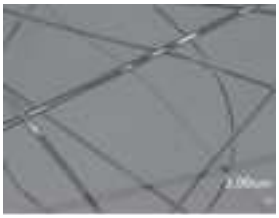

Nonwovens (PAN)


Nonwovens
(Ethyl cellulose)


Beaded fiber (PI)


Ribbon-shape fiber (PAN)


Nonwovens
(Cellulose acetate)

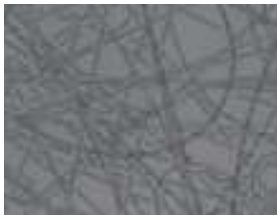

Nonwovens (Chitosan)


Aligned sheet (PES)


Aligned sheet (PLLA)


Hollow fiber (PMMA)


Interconnected structure
(PCL)


Nonwovens (Gelatin)


Nonwovens (Collagen)

Components for Electrospinning ; Collector series

Nanofibers will be spun by polymer jets coming from a spinneret, when applying high voltage at 20 - 50kV, to a grounded collector.
Various shapes/modes of nanofibers can be made by choosing following collectors.

Plate Collector

A collector to spin nonwoven sheets. Convenient to make samples quickly and to calculate spinning .

Sample size:
- *200 x 150 mm*
- *600 x 150 mm*

Drum Collector

A collector to spin nonwovens and aligned sheets.
Aligned nanofibers can be made by rotating the collector at high speed such as 3000 rpm.

Sample size:
- *200 x 600 mm*
- *200 x 300 mm*
- *30 x 600 mm*
- *600 x 600 mm (No alignment)*

Mandrel Collector

A collector to spin nanofiber tubes typically used for medical applications.

Inner diameter of tubes:
1 / 2 / 3 / 4/ 6 / 8 / 10 mm
Tube length: 150mm / 450mm

Disk Collector

A collector to spin aligned nanofiber bundles.

Sample length: 600mm

Roll to Roll Collector

A collector to spin long nanofiber sheets.
Alminum foils can be used as base materials.

Typical sample size:
- *200 x 10 mm*
- *450 x 10 mm*

Y-axis Slide Collector

A collector modiffied from the plate collector to move on Y-axis while moving a spinneret on X-axis.

Stroke: +/- 25mm
Speed: 0 to 10mm
Sample size: 250 x 125 mm

【Plate Collector】

Product	Model	System
Plate collector 250x150	C-PL/250x150	NANON, NF
Plate collector_600x150	C-PL/600x150	NF-500

【Drum Collector】

Product	Model	System
Drum Collector_φ200W200	C-DR/D200W200	NANON, NF
Drum Collector_φ100W200	C-DR/D100W200	NANON, NF
Drum Collector_φ200W30	C-DR/D200W30	NANON, NF
Drum Collector_φ200W600	C-DR/D200W600	NF-500

【Disk Collector】

Product	Model	System
Disk collector	C-DI/D200	NANON, NF

【Mandrel Collector】

Product	Model	System
Mandrel Collector	C-MA/L150	NANON, NF
Mandrel Collector	C-MA/L450	NF-500

【Roll to Roll Collector】

Product	Model	System
RtoR collector/W200	C-RR/200	NANON, NF
RtoR collector/W450	C-RR/450	NF-500
RtoR controller	C-RR-OP	NANON

【Y-axis Slide Collector】

Product	Model	System
Y-axis slide collector	C-YA	NANON
Y-axis collector controller	C-YA-OP	NANON

Components for Electrospinning; Spinneret series

Spinnerets also called "nozzles" receives high voltages at 20 to 50kV on their outlets and polymer solution jets will be injected to grounded collectors to spin nanofibers.
Various shapes/modes of nanofibers can be made by choosing following spinnerets by the combination with collectors.

Clip Spinneret

A standard spinneret for NANON and NF series to spin various nanofibers quickly and easily. 3 syringes can be mounted.

Maintenance is also easy because no cleaning is required other than a metal connector.

Vertical Clip Spinneret

A clip spinneret of vertical syringe arrangement to obtain nanofibers in wider area.
Features easy handling and cleaning.

11-syringe Clip

A clip spinneret that can accommodate a maximum of 10 syringes.
(There are 11 holes.)
Integratable only to NF-500.
Features easy handling and cleaning.

Multi-Jet Spinneret (MJS)

A spinneret with multiple jet outlets to spin nanofibers effectively.Numbers of outlets can be chosen in accordance with materials.
Features spinning of high productivity at low voltages.
Number of outlets: 4 / 6 / 8 /

【*Clip spinneret / Vertical clip*】

Product	Model	System
Clip Spinneret_75	S-CL/75	NANON, NF-103
Clip Spinneret_100	S-CL/100	NF -500
Vertical clip spinneret_75	S-VCL/75	NANON, NF-103
Vertical clip spinneret_100	S-VCL/100	NF-500

【*11-syringe Nozzle*】

Product	Model	System
11-syringe Nozzle_100	S-11N/100	NF

【*Multi-jet spinneret (MJS)*】

Product	Model	System
Multi-jet spinneret_*_75	S-MJ/*/75	NANON, NF-103
Multi-jet spinneret_*_100	S-MJ/*/100	NF-500
MJS holder	S-MJ-H/75	NANON, NF-103
MJS holder	S-MJ-H/100	NF-500

** number of jet outlets; 4, 6, 8, 12 or 22*

Coaxial Spinneret

A spinneret to spin core/shell-structure nanofibers.
Models for different syringes of 18G, 22G and 27G are available.

Inner diameter
18G: Core φ0.94mm Shell φ2.5mm
22G: Core φ0.48mm Shell φ1.4mm
27G: Core φ0.22mm Shell φ0.8mm

Tubeless Spinneret

A spinneret directly to push a syringe to save solutions to be remained in a tube.

Ideal for evaluation of spinning performance of various solutions and

Solution Heating

A spinneret to heat solutions up to 200 degreeC by iduction heating without direct contact.

Comes with a special power supply and a temperature controller.

Ideal for the case solvents cannot be used or materials cannot be spun at ordinary temperature.

【*Coaxial Spinneret*】

Product	Model	System
Coaxial spinneret 18G_75	S-CL/18G/75	NANON, NF-103
Coaxial spinneret 22G_75	S-CL/22G/75	NANON, NF-103
Coaxial spinneret 27G_75	S-CL/27G/75	NANON, NF-103
Coaxial spinneret 18G_100	S-CL/18G/100	NF-500
Coaxial spinneret 22G_100	S-CL/22G/100	NF-500
Coaxial spinneret 27G_100	S-CL/27G/100	NF-500
Coaxial spinneret for NW	S-CL/NW	NW-103

【*Tubeless Spinneret*】

Product	Model	System
Tubeless Spinneret_75	S-TU/75	NANON, NF
Tubeless Spinneret_100	S-TU/100	NF

【*Solution heating spinneret*】

Product	Model	System
Solution Heating Unit	S-HU/100	NF-103, NF-500
Solution for Heating	S-H-S/100	NF-103, NF-500
Solution heating_75	S-MJ/****	NF-103
Solution heating_100	S-SH/100	NF-500
Induction heating power supply	IHP-101	NF-103, NF-500
MJS Holder_100	S-SH-TC	NF-103, NF-500

Components for Electrospinning;
High voltage / Induction heating power supply

The DC high voltage power supply to apply high voltage at tens of kilovolts to spinnerets to spin nanofibers.
There are 30kV/40kV/50kV models of positive or negative polarity, which can be integrated to the NF series.
An induction heating power supply is also available to heat solutions without direct contact or solvents.

HVU series

Product	Model	System
High Voltage Unit_30P100	HVU-30P100	+30kV, 100μA
High Voltage Unit_30N100	HVU-30N100	-30kV, -100μA
High Voltage Unit_40P100	HVU-40P100	+40kV, 100μA
High Voltage Unit_40N100	HVU-40N100	-40kV, -100μA
High Voltage Unit_50P100	HVU-50P100	+50kV, 100μA
High Voltage Unit_50N100	HVU-50N100	-50kV, -100μA
Induction Heating	IHP-101	Heating from 50℃ to 200℃

Syringe pump / Gear pump

A syringe pump and a gear pump to supply sppinerets with solutions.

Syringe pump

A syringe pump typically used to spin core/shell nanofibers.

Gear pump

A gear pump for NW and NF-1001, which can supply solutions continuously.

Product	Model
Syringe Pump	YSP-101 (YMC)

Product	Model
Gear Pump	P-GR
Gear Pump Controller	P-GR-OP

Connectors

TAC connector

Metal connector

Luer-lock connector

Needle connector

Connectors to joint syringe needles with spinnerets.
There are some models for each spinneret.

Product	Model	Spinneret
Metal Connector M-539-055A	M-539-055A/CL	Clip
Metal Connector M-539-057	M-539-057/CA	Coaxial
Needle Connector M-539-755	M-539-755/TU	Tubeless
Luer-lock Connector VRF106	M-VRF106	
TAC Connector BF3.2-M3-SUS	M-TAC-BF3.2	
Hose Nipple MS-5H-6	M-MS-5H-6	

Miscellaneous

Dehumidifier
Controls humidity inside the spinning chamber.
(Off-the-shelf product only for the NANON.)

Tefron tube
Supplies solutions between a syringe and a spinneret.

Cleaning tube
Silicon tube to clean a tip of a spinneret.

Charcoal Filter
To absorb organic solvents.

Neutral Filter
To collect nanofiber particles.

Syringe
Syringe to supply solutions.
(Volume: 5ml)

Syringe Needle
27G (15mm, 22mm)
22G (15mm, 24mm)
18G (15mm, 24mm)

Consultation / Sample Making

Experienced staff at MECC are willing to provide technical supports with knowledge and data that have been accumulated for a long time period.
They calculate spinning conditions to spin designated materials into nanofibers, which can save much time and cost to be spent by our customers.
Any orders for small quantity or wide / long sheets can be accepted.

【Workflow of sample making】

Inquiry by phone or e-mail

↓

Hearing by MECC staff

- Material
- Thickness
- Fiber diameter
- Size
- Weight

↓

Quotation by MECC

↓

Purchase order by Customer

↓

Preparation of materials

- To be arranged by a customer or MECC

↓

Preliminary test

- Judgment of feasibility

↓

Discussion

- Discussion to proceed to next step

↓

Making samples

↓

Delivery

- Delivery of samples and data (reports)

【List of materials electrospun to nanofibers】

Abbreviation	Chemical Name	Min/Max Fiber Diameter
PVDF	Polyvinylidene fluoride	300nm to 1.4μm
PEO	Polyethylene oxide	400nm to 1.3μm
PVA*	Polyvinyl alcohol	300nm to 2.3μm
PLLA*	Poly-L-lactic acid	400nm to 3.0μm
Nylon6,6	Nylon6,6	300nm to 2.7μm
Nylon6	Nylon6	100nm to 1.0μm
PET	Polyethylene terephthalate	400nm to 1.8μm
PS	Polystyrene	400nm to 8.5μm
PU	Polyurethane	400nm to 1.2μm
PMMA	Poly methyl methacrylate	900nm to 3.0μm
PP	Polypropylene	1.5μm to 12.0μm
PE	Polyethylene	900nm to 3.0μm
PSU	Polysulfone	400nm to 1.4μm
PAN	Polyacrylonitrile	300nm to 5.0μm
PCL*	Polycaprolactone	500nm to 15.0μm
PLGA*	Poly (lactic-acid-glycolic acid)	1.0μm to 3.0μm
PES	Polyethersulfone	400nm to 2.6μm
PEG	Polyethylene glycol	700nm to 2.4μm
CA*	Cellulose acetate	400nm to 5.1μm
PI	Polyimide	400nm to 600nm

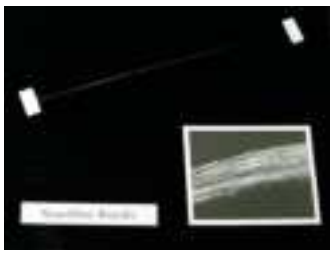
**Biodegradable polymer*
Note: Materials of some manufacturers may be difficult to be spun or some materials may not be adequate for mass production.

【Photo of samples】

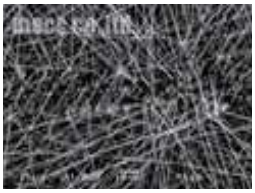

Alinged sheet (PLLA)


Nonwovens (PAN)


Nanofiber tube (PU)

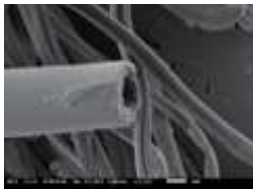

Nanofiber bundle (PLLA)

【SEM images】


Nonwovens


Aligned sheet


Beaded nanofiber


Hollow nanofiber


Nanofilament

Typical Customers

JAPAN
- Tokyo University
- Kyoto University
- Tokyo Institute of Technology
- Tohoku University
- Kyoto Institute of Technology
- Kyushu University
- Shinshu University
- Fukui University
- Nagoya University
- Kobe University
- NIMS
- AIST
- RIKEN

KOREA
- KAIST
- UNIST
- Joowon Industrial

SINGAPORE
- National University of Singapore
- Nayang Technology
- Clearbridge

THAILAND
- TISTR

CHINA
- Zhejiang University
- Shanghai Jiao Tong University
- Sichuan University
- Beijing University of Chemical Technology
- Nanjin Biaojiao Scientific and Technic

TAIWAN
- National Taiwan University
- National Taiwan Normal University
- Ming-Chi University of Technology
- Academia Sinica
- Coating P. Materials

SAUDI ARABIA
- King Saud University
- KFUPM

EGYPT
- Zewail University
- American University of Cairo

INDIA
- Naval Material Research Laboratory

GERMANY
- DIK

PORTUGAL
- Centi

FRANCE
- Paris-Sud University

SPAIN
- LEITAT

ITALY
- M. Penati Strumenti
- CNR-IPCB
- IIT-Istituto Italiano di Tecnologia
- Università degli Studi di Pavia

IRELAND
- Trinity College

POLAND
- IFTR of Polish Academy of Sciences

RUSSIA
- Labtest

AUSTRALIA
- University of Wollongong

U.S.A.
- University of Washington
- Vanderbilt University
- Georgia Southern University

CANADA
- University of British Columbia
- University of Guelph

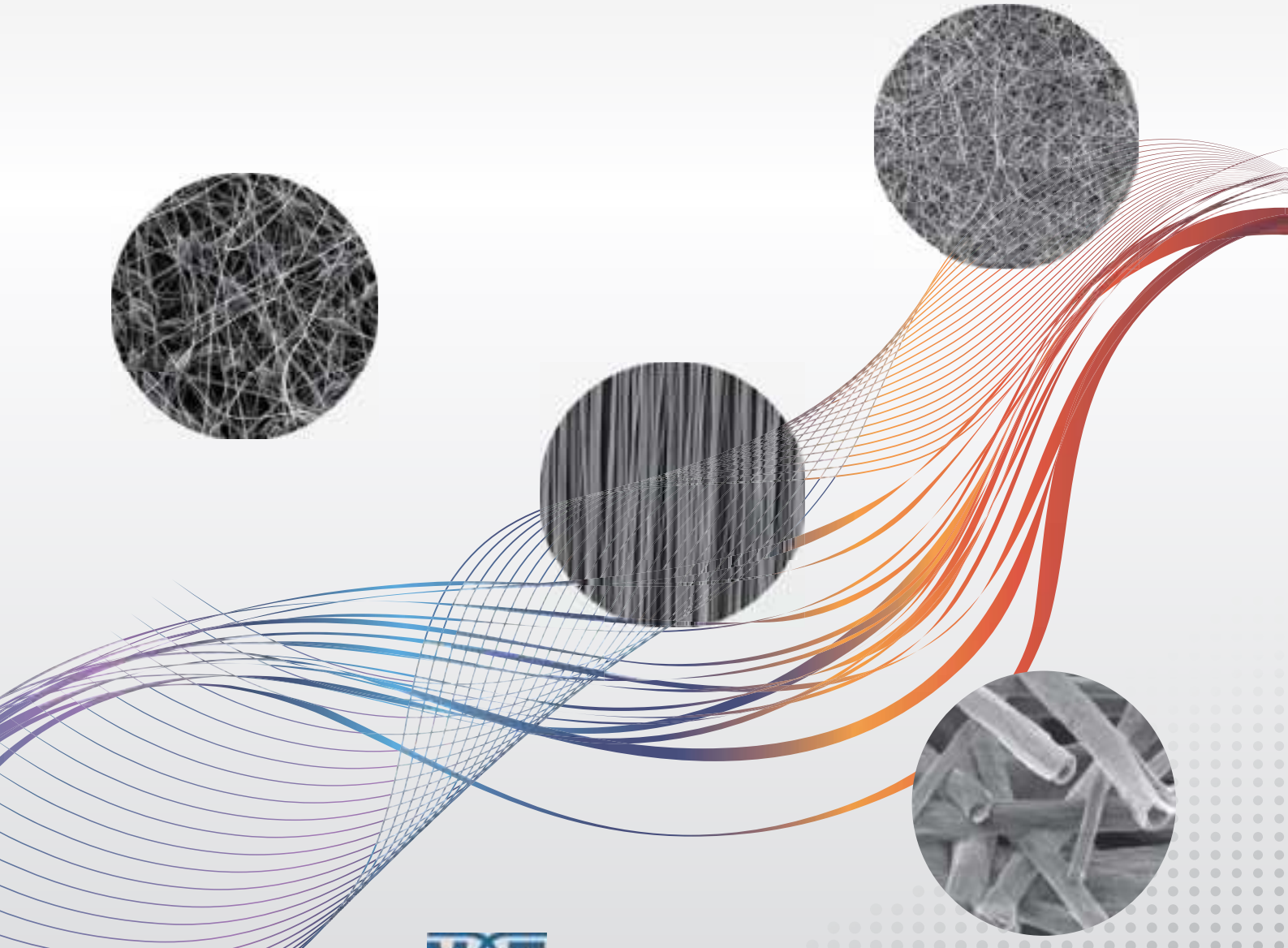
Corporate Profile

Name	MECC CO., LTD.
Address	196-1 Fukudo, Ogori-shi, Fukuoka 838-0137 JAPAN
President	Megumi Usui
Business Operation	• Development and manufacturing of electronic equipment • Operation of cable television (broadcasting and internet provider)
Number of Employees	55
Capital	JPY 40,000,000. (USD 400,000)
Establishment	May 1973
Correspondent Bank	Nishinihon City Bank, Fukuoka Bank, Mizuho Bank
Factory	196-1 Fukudo, Ogori-shi, Fukuoka 838-0137 JAPAN
Access	45minutes' drive from Fukuoka airport 8 minutes' drive from JR Tosu station

MECC Headquarters

Location of Fukuoka, Japan
From Fukuoka; Tokyo 900km, Seoul 550km, Shanghai 870km

Contributing to the World with “Only One” Technology.



MECC CO., LTD.

196-1 Fukudo, Ogori-shi, Fukuoka 838-0137 JAPAN
Phone +81-942-41-2900 Fax +81-942-41-2205
URL: www.mecc-nano.com E-mail: askmecc@mecc.co.jp