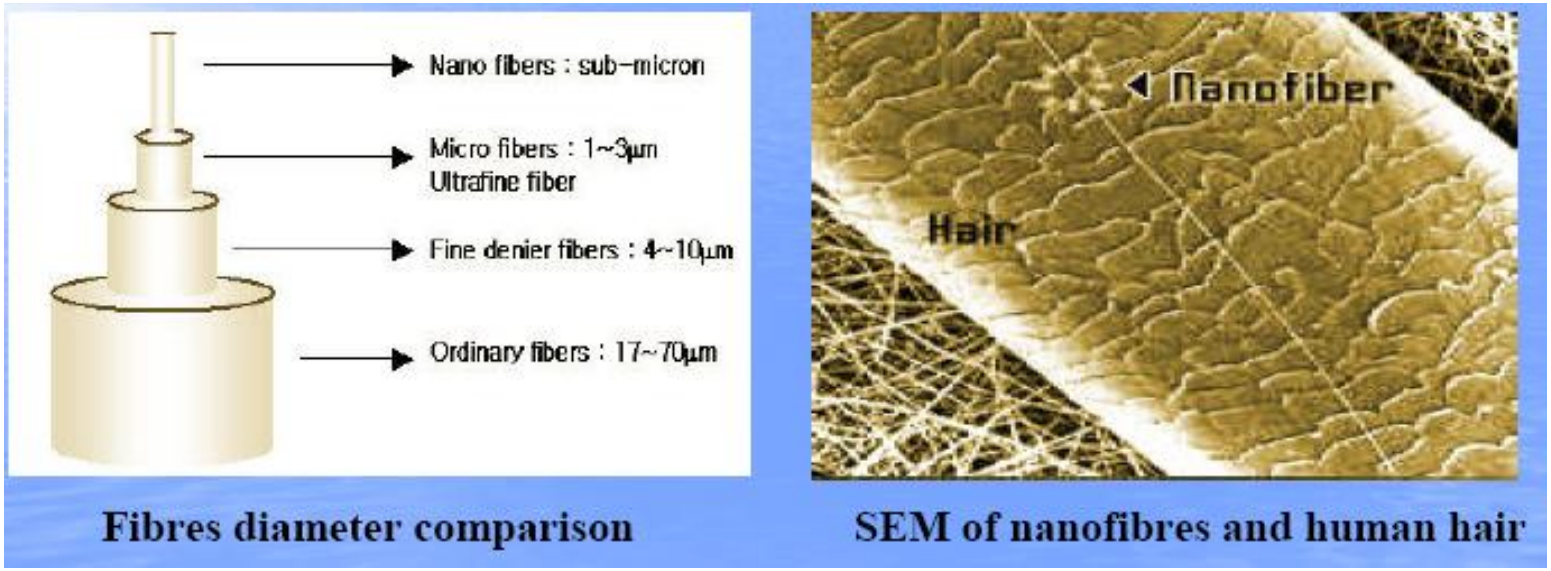
FNM Co.

Our products related to Electrospinning and Nanofibers

Nader Naderi

CEO

Nanofibers



Fibres diameter comparison

SEM of nanofibres and human hair

4.34 nanofibre

nano-object with two similar external dimensions in the nanoscale and the third dimension significantly larger

NOTE 1 A nanofibre can be flexible or rigid.

NOTE 2 The two similar external dimensions are considered to differ in size by less than three times and the significantly larger external dimension is considered to differ from the other two by more than three times.

NOTE 3 The largest external dimension is not necessarily in the nanoscale.

[ISO TS 27687:2008, definition 4.3]

About us

Fanavaran Nano-Meghyas (FNM Co. Ltd.;) was founded in 2004, is a knowledge based company and its goals are the development of nanofibers technology and its applications. FNM's products and services are design and production of electrospinning machines in lab, pilot and industrial scales as well as melt, force and blown electrospinning systems, with various accessories (High Voltage power supplies, Syringe Pumps and collectors), with focus on producing of respiratory face mask, power plant and automotive air and oil filters, window screen, vacuum cleaner bags, cosmetic face masks, wound dressing and etc. based on electrospun nanofibers.

Name of Company:	Fanavaran Nano-Meghyas (FNM Co. Ltd.)
E-mail:	fnm.ir.co@gmail.com, info@fnm.ir
Office:	No. 8, 4th Floor, Unit 8, Hamadan Alley, Amirabad St., Tehran
Factory:	No. 505 , Gholami St, Sanobar St., Parsa Sq., Ahmadabad Mostoufi, Tehran, Iran
Nanocare Branches	Tirajhe Shopping center, Arg Tajrish Shopping center, nanocare.ir website
Tel.:	+98 (21) 65612497
ICANANO	ICAN; NANO site; Sh. Ehsani Rad ST., Engelab St., Parsa Sq., Ahmadabad Mostoufi Rd., Azadegan Highway, Tehran, Iran

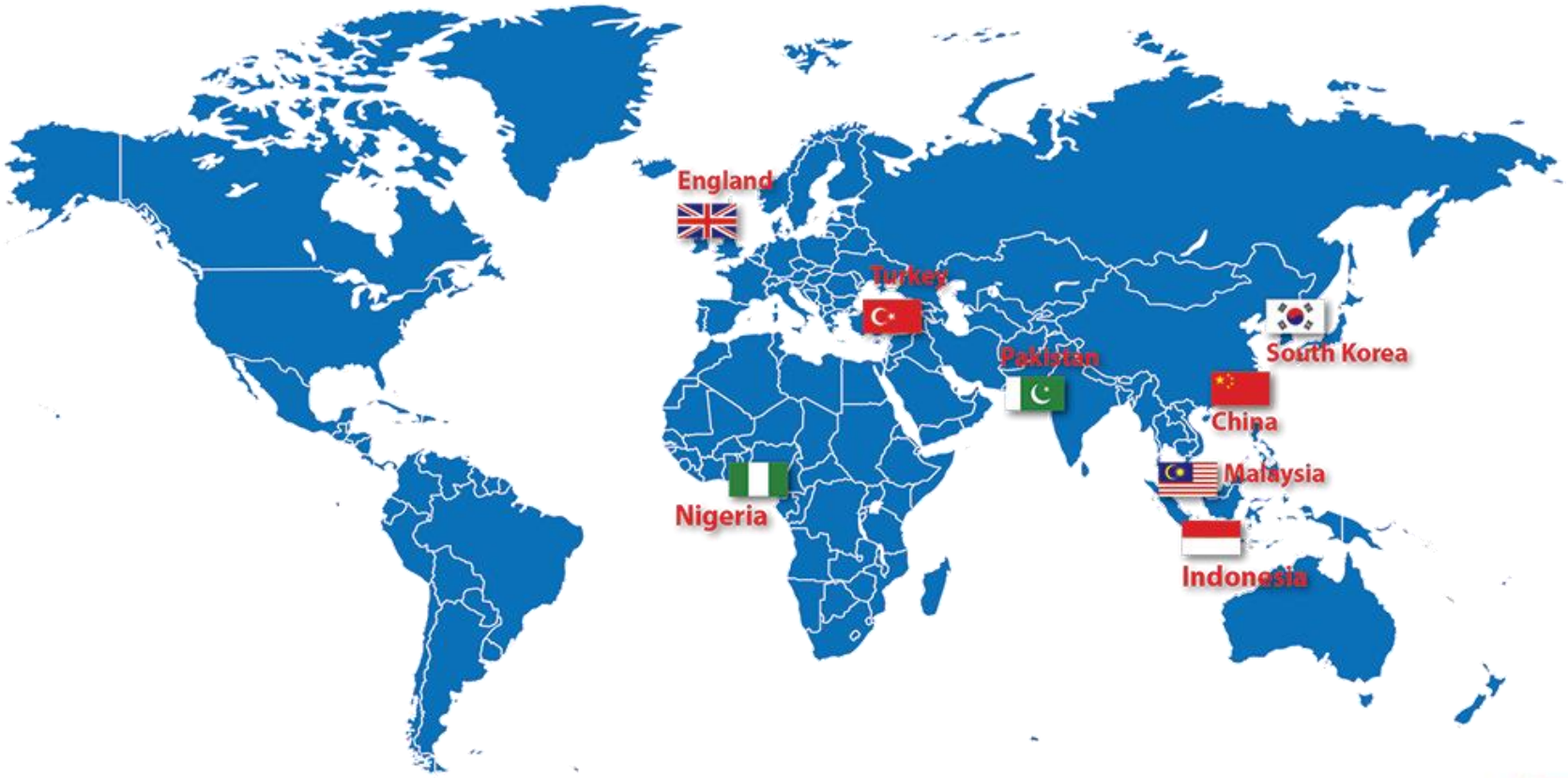
Awards, Verification and Standards

- Ranked eighth in International Nanotechnology Festival-Tehran (2009).
- Award for research project at the Festival of Science to Practice (December 2010)
- Third laureate R&D 25th Khwarazmi international Award, 5th Feb 2012 Tehran, Iran.
- Academy of science award in developing countries (TWAS); UNESCO, 2012
- Second rank in Technology at 6th National Nano-Awards Festival, October, 2011, Tehran, Iran.
- First laureate nano products award at 11th National Nano-Awards Festival, October, 2016, Tehran, Iran.
- Award for high tech export at 12th National Nano-Awards Festival, October, 2017, Tehran, Iran.
- Award for high tech export at 13th National Nano-Awards Festival, November, 2018, Tehran, Iran.
- 5 star export company 2021, Iran High-tech Export Club
- National Export Prize, Iran ministry of industry mine and trade, 2022
- Razi Medical Science Award for invention, Ministry of health, 2020
- 5 International and 12 Iranian Patents

ISO 13485

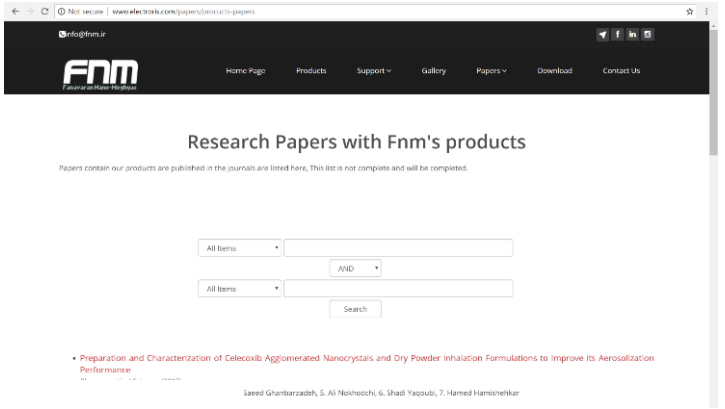
5 star export company

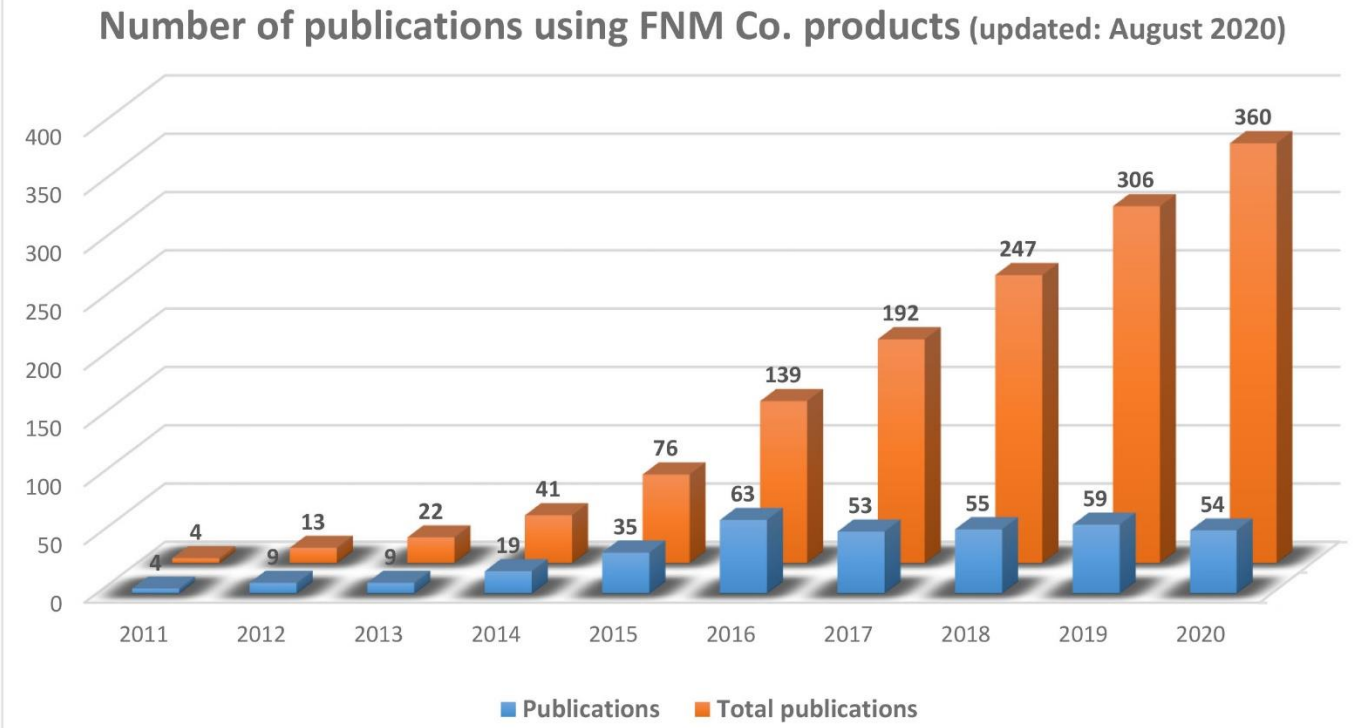
Today there are 8 overseas offices/sale representative, in Shanghai (China), Suzhou (China), Kuala-Lumpur (Malaysia), Jakarta (Indonesia), London (United Kingdom), Istanbul (Turkey), Germany and Islamabad (Pakistan).



Citations to our Products in Research Papers

More than 360 published research papers (updated 2020). Citations are available on our website (http://en.fnm.ir/papers/products-papers)





Company Facilities

Analysis Equipment

- Scanning Electron Microscopy (SEM)

- FNM Filter Test machine

FNM Filter/Mask Test Machine

دستگاه تست فیلتر

Specifications

		FT150EA	FT200PO	FT200PS
Test Modes	Pressure drop test	✓	✓	✓
	Air permeability test	✓	✓	✓
	Filtration Efficiency Test	Atmospheric	Oil Particles	Oil and Salt Particles
	Bubble Point	×	Optional	Optional
Standards	BS EN 149	✓	✓	✓
	BS EN 779	✓	✓	✓
	ISO 16890	✓	✓	✓
	ISO 16900-3	✓	✓	✓
	ISO 11155-1	✓	✓	✓
	ISO 5011	✓	✓	✓
Control	PLC	✓	✓	✓
	HMI	7"	7"	7"
	Ambient Temp.	×	✓	✓
Air flow	Flow	10 - 150 l/min	10 - 200 l/min	10 - 200 l/min
	Digital control	✓	✓	✓
Media Holder	Area	100 cm^2	20, 50 and 100 cm^2	20, 50 and 100 cm^2
Sensors	Temperature	✓	✓	✓
	Relative Humidity	✓	✓	✓
	Digital Tank Pressure Control	×	✓	✓
	Tank Pressure	1 – 8 bar	1 – 8 bar	1 – 8 bar
Pressure Drop	Pressure Drop	0 – 1200 Pa	0 – 1200 Pa	0 – 1200 Pa
	Digital control	✓	✓	✓
Air Dryer	Air Line Trap	✓	✓	✓
	Dryer System	×	✓	✓
Particle Counter	Laser Particle Counter	1	2	2
	Channels	six-channel	six-channel	six-channel
	Channel Sizes	0.3, 0.5, 1, 2.5, 5, 10 µm	0.3, 0.5, 1, 2.5, 5, 10 µm	0.3, 0.5, 1, 2.5, 5, 10 µm
	Flow rate	2.8 L/min	2.8 L/min	2.8 L/min
Aerosol Generator (Oil)	Generator	×	✓	✓
Aerosol Generator (Salt)	Generator	×	×	✓
	Neutralizer	×	×	✓
Aerosol Dilutor	Particle Dilution	×	100:1	100:1
	Type of Aerosol Challenge	×	PSL, PAO, DOP	PSL, PAO, DOP, NaCl
Printer		Optional	Optional	✓
Respiratory Face Mask Holder		Optional	Optional	Optional
Power		Single phase, 220 V, AC	Single phase, 220 V, AC	Single phase, 220 V, AC
Weight (kg)		About 170 kg		
Size, (Length, Width, Height)		94 cm, 92 cm, 163 cm		

lab-scale Electrospinning machines

Lab-Scale Electrospinning unit

Industrial Electrospinning machine

INFL260B

Yield of

Up to 20 g/hr

Industrial Electrospinning machine

INFL6100B

Yield of

Up to 100 g/hr

Nanofiber sizes of

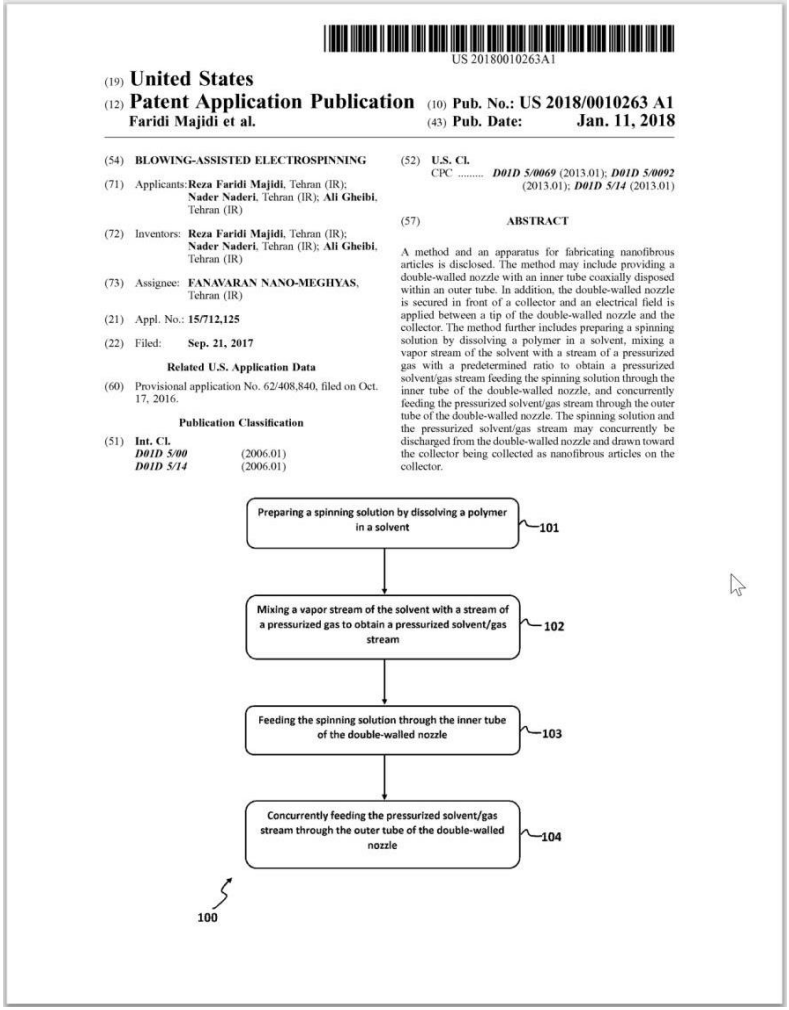
60-400 nm*

**depending on polymer solution and electrospinning parameters*

Our innovation in electrospinning

Blowing-Assisted Electrospinning

US, China and EU Patent



US 20180010263A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2018/0010263 A1**

Faridi Majidi et al. (43) **Pub. Date: Jan. 11, 2018**

(54) **BLOWING-ASSISTED ELECTROSPINNING**

(71) Applicants: **Reza Faridi Majidi**, Tehran (IR); **Nader Naderi**, Tehran (IR); **Ali Gheibi**, Tehran (IR)

(72) Inventors: **Reza Faridi Majidi**, Tehran (IR); **Nader Naderi**, Tehran (IR); **Ali Gheibi**, Tehran (IR)

(73) Assignee: **FANAVARAN NANO-MEGHYAS**, Tehran (IR)

(21) Appl. No.: **15/712,125**

(22) Filed: **Sep. 21, 2017**

Related U.S. Application Data

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Publication Classification

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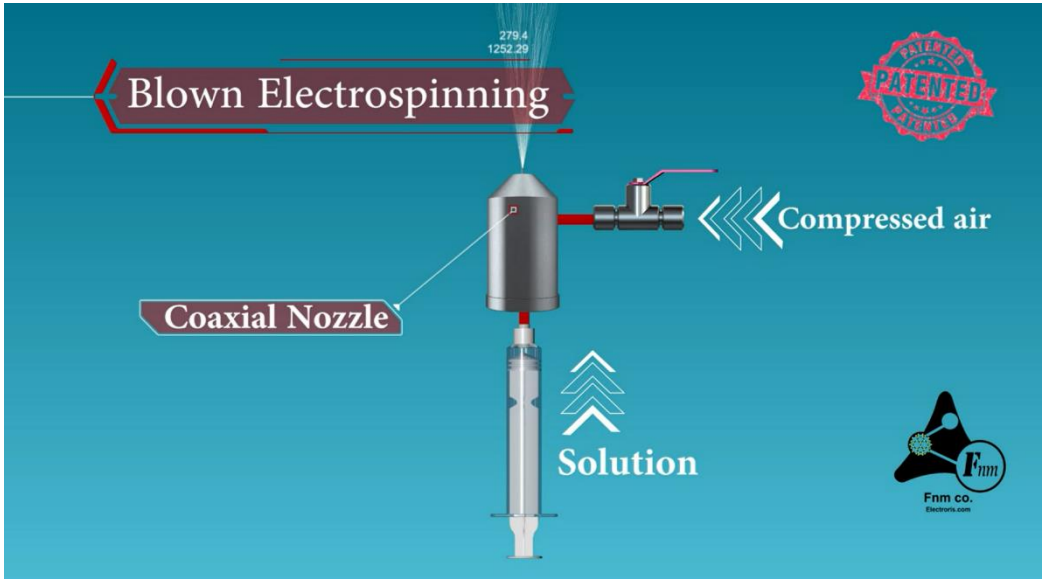
(52) **U.S. Cl.**
CPC ***D01D 5/0069*** (2013.01); ***D01D 5/0092*** (2013.01); ***D01D 5/14*** (2013.01)

(57) **ABSTRACT**

A method and an apparatus for fabricating nanofibrous articles is disclosed. The method may include providing a double-walled nozzle with an inner tube coaxially disposed within an outer tube. In addition, the double-walled nozzle is secured in front of a collector and an electrical field is applied between a tip of the double-walled nozzle and the collector. The method further includes preparing a spinning solution by dissolving a polymer in a solvent, mixing a vapor stream of the solvent with a stream of a pressurized gas with a predetermined ratio to obtain a pressurized solvent/gas stream feeding the spinning solution through the inner tube of the double-walled nozzle, and concurrently feeding the pressurized solvent/gas stream through the outer tube of the double-walled nozzle. The spinning solution and the pressurized solvent/gas stream may concurrently be discharged from the double-walled nozzle and drawn toward the collector being collected as nanofibrous articles on the collector.



Blowing-Assisted Electrospinning

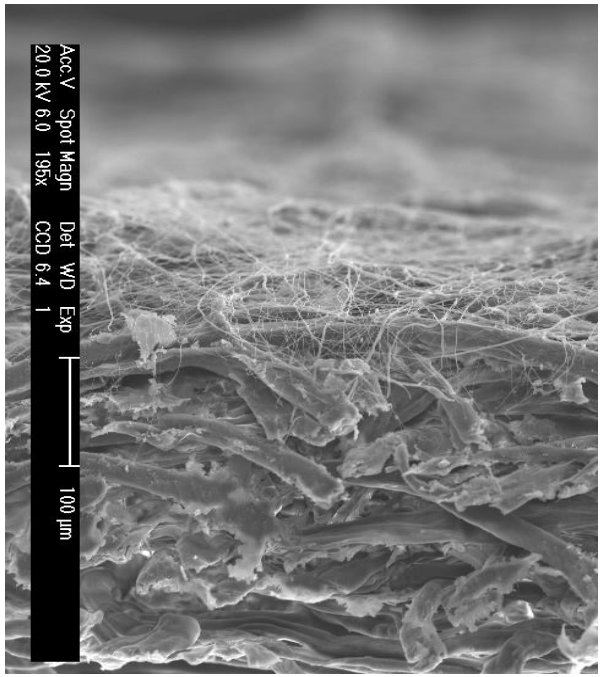
Comparison of different electrospinning methods

Method	Production rate*	CONSTANT Solution Concentration	Flexibility (variety of materials)	Solution waste**	flammability	Adhesion to support layer	Thick nanofiber mat
Multineedle electrospinning	Poor 2gr/h/unit (10 needles)	Excellent	Good	Very Low<5%	Very Low	Low	Medium
Bath/Dip electrospinning	Medium 3gr/h/unit	Poor	Poor	High >50%	High	low	Low
Cartridge electrospinning	Medium 4gr/h/unit	Poor	Medium	Medium >25%	Medium	Low	Low
Blowing- assisted electrospinning	**High** **12gr/h/unit**	**Excellent**	**Excellent**	**Very low** **<5%**	**Very Low**	**High**	**High** **Up to 2 mm**

*Polyamide

**Based on repeated internal testing*

Nanofibers on filter paper



VTT EXPERT SERVICES LTD

TEST REPORT No. VTT-S-05145-12 Appendix 1 1 (1)

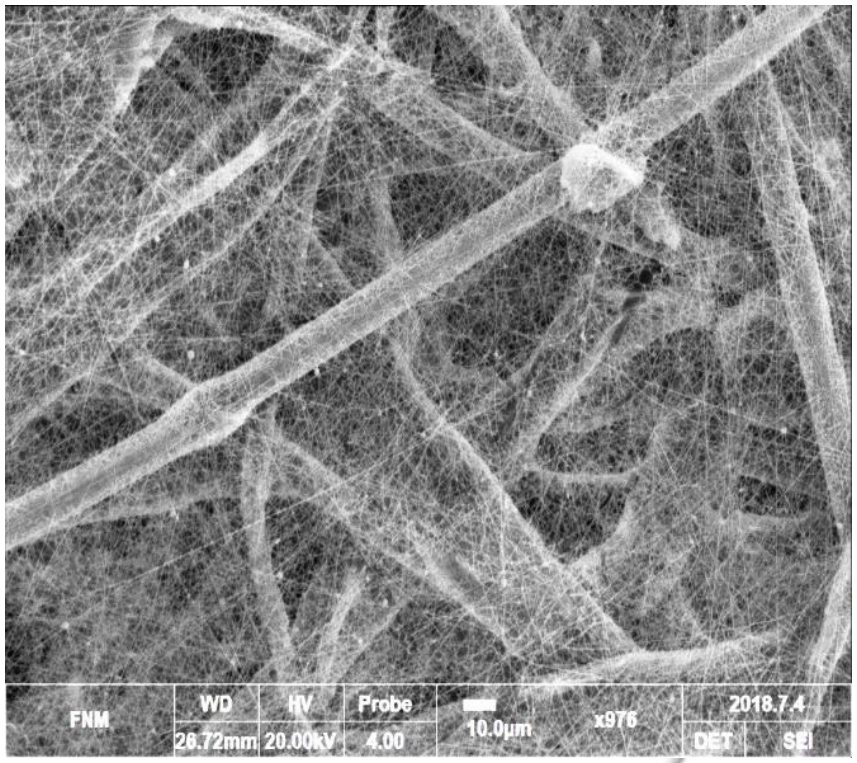
EN 779:2002. AIR FILTER TEST RESULTS

TEST DATA

Test air flow rate	Test air temperature	Test air relative humidity	Test aerosol	Loading dust
0.347 m³/s	24 - 25 °C	38 - 43 %	DEHS	ASHRAE

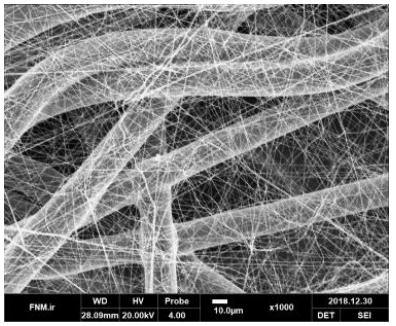
RESULTS

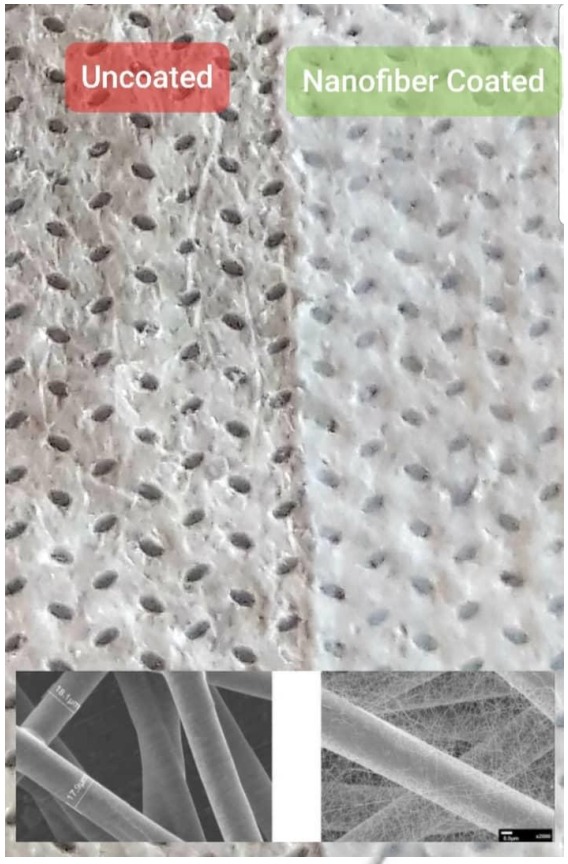
Initial pressure drop	Initial arrestance	Initial efficiency (0,4 µm)	Dust holding capacity	Untreated / discharged
238 Pa	>99 %	72 %	8 / 226 / 504 g	efficiency of filter
Final pressure drop	Average arrestance	Average efficiency (0,4 µm)	Filter class (450 Pa)	material (0.4 µm)
250 / 350 / 450 Pa	>99 / >99 / >99 %	79±1 / 97±0 / 99±0 %	F9 (0.347 m³/s)	Non Applicable
Remarks: -				
NOTE: The performance results cannot by themselves be quantitatively applied to predict filter performance in service. The results relate only to the tested item.				



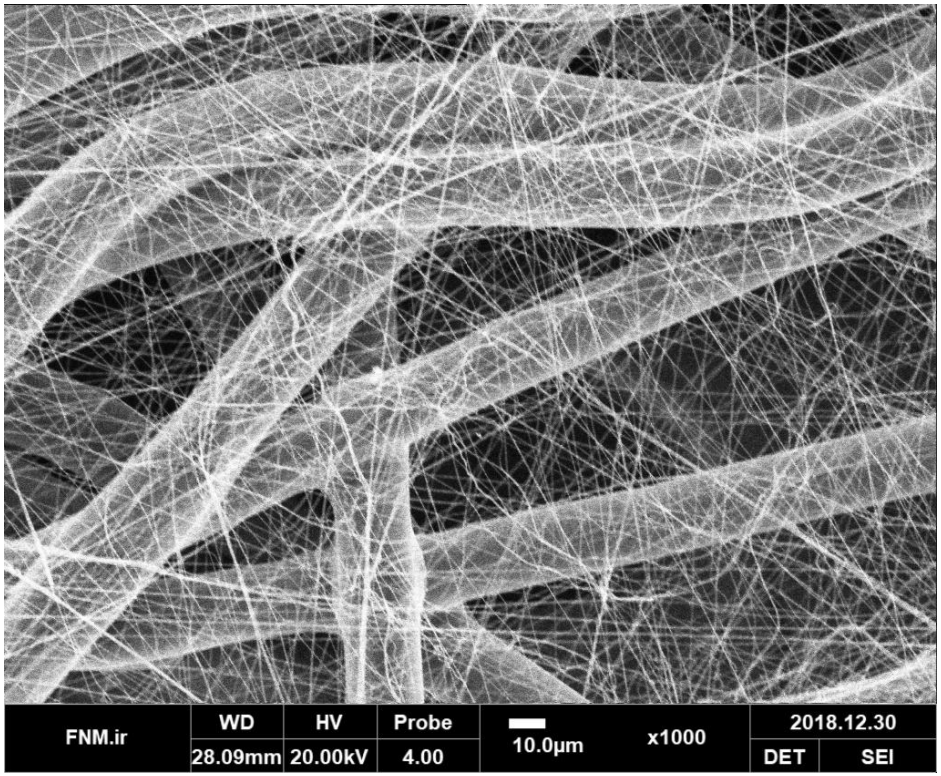
Respiratory Face Mask

Respinano
NanoFiber Mask





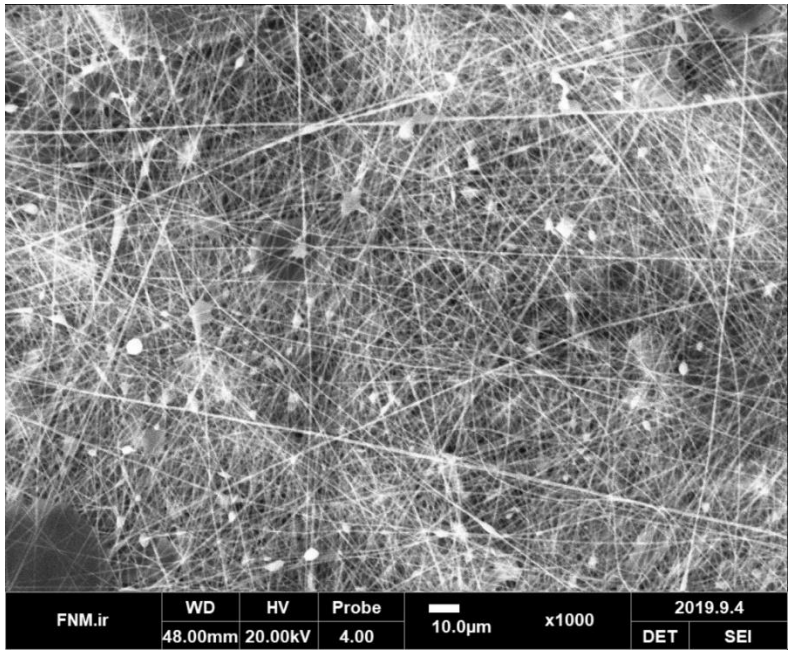
Nanofiber-based Anti-Allergy Bedding Test Results



SEM image of nanofiber-based anti-allergy bedding

Nanofiber-based anti-allergy bedding substrate

Nanofiber-based Beauty Face Mask Test Results

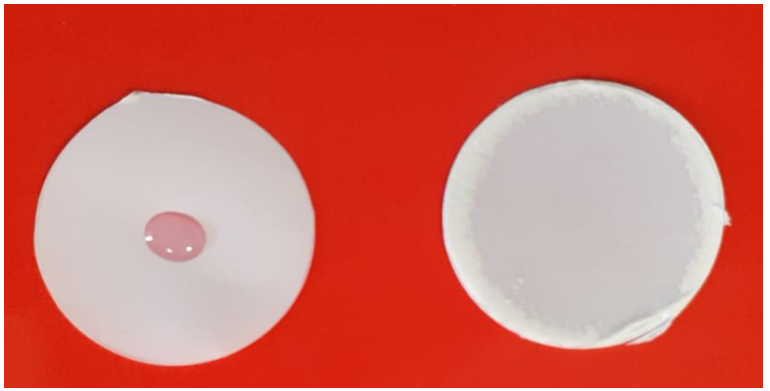


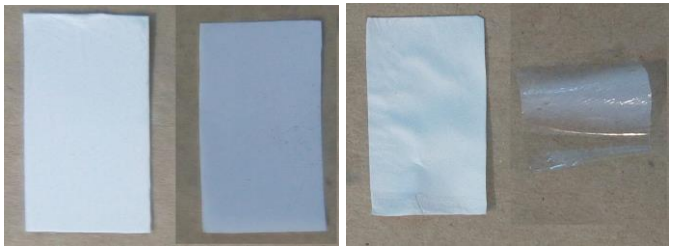
SEM image of nanofiber-based beauty face mask

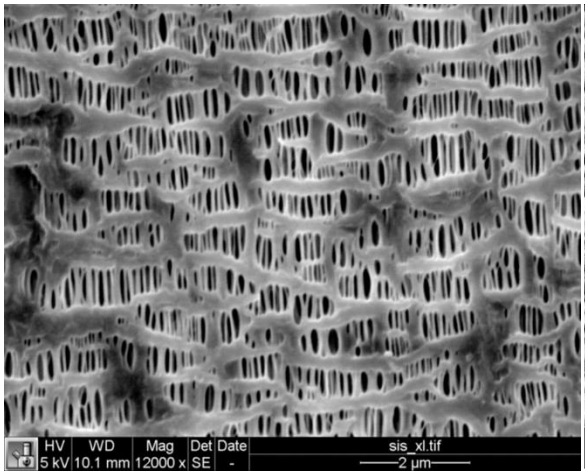
Beauty Face Mask

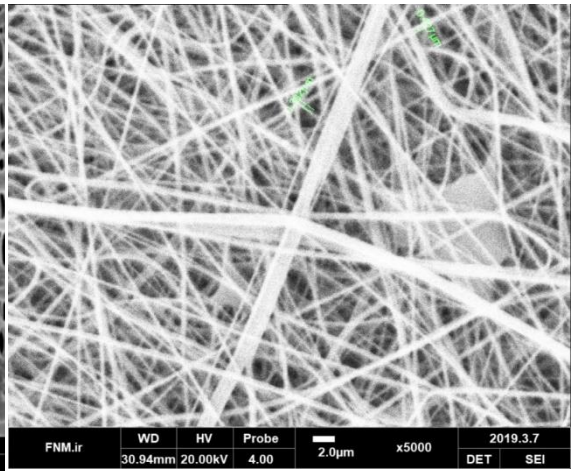
FNM Separators in Lithium-Ion Battery

1. The porosity is more than 60%
2. Electrolyte uptake 500%
3. Thermal stability above 180 ° C
4. High ionic conductance
5. No battery electrolyte leakage
6. Higher safety offered by high heat resistance
7. Shorter processing time for electrolyte injection









Sample	Electrolyte uptake (%)	Porosity (%)	Ionic conductivity ($mS.cm^{-1}$)
PP	86	36	**0.8**
FNM	500	65.02	**2.3**

Industrial NanoFiber Production Line

INFL6100B

Model	Units	Width (cm)	Nozzels	Autofill	Dryer section	Coating Speed for PFE95% (m/h)	Coating Speed for F9 Filter (m/h)	media for 95% mask Per an hour (pcs)	media for 80% mask Per an hour (pcs)
INFL160C	1	60	*	*	*	20	35	300	480
INFL260C	2	60	*	*	*	40	70	600	960
INFL2100C	2	100	*	*	*	40	70	1000	1600
INFL4100C	4	100	*	✓	✓	75	130	1875	3000
INFL6100C	6	100	*	✓	✓	100	200	2500	4000
INFL6160C	6	160	*	✓	✓	100	200	4000	6400
INFL260B	2	60	8	*	*	60	150	900	1440
INFL2100B	2	100	16	✓	✓	60	150	1500	2400
INFL4100B	4	100	32	✓	✓	120	300	3000	4800
INFL4160B	4	160	48	✓	✓	120	300	4800	7680
INFL6100B	6	100	48	✓	✓	220	450	5500	8800
INFL6160B	6	160	72	✓	✓	220	450	8800	14080

* each square meter is enough for about 25 pcs of masks

the RespNano NanoFiber Mask

Thank you for your attention!

Respinano
NanoFiber Mask

RIMA
Be aware, take care!

nanocare
nanocare.ir