Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.
This journal is © The Royal Society of Chemistry 2016

Supplementary Information

Micro-wave structured polyamide-6 nanofiber/nets membrane with embedded poly(*m*-phenylene isophthalamide) staple fibers for effective ultrafine particle filtration

Shichao Zhang,[ac] Hui Liu,[bc] Jianyong Yu,[c] Wenjing Luo[d] and Bin Ding*[abc]

[a] State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Donghua University, Shanghai 201620, China.

[b] Key Laboratory of Textile Science & Technology, Ministry of Education, College of Textiles, Donghua University, Shanghai 201620, China.

[c] Nanofibers Research Center, Modern Textile Institute, Donghua University, Shanghai 200051, China.

[d] Department of Occupational and Environmental Health, School of Public Health, Fourth Military Medical University, Xi'an, Shanxi 710032, China.

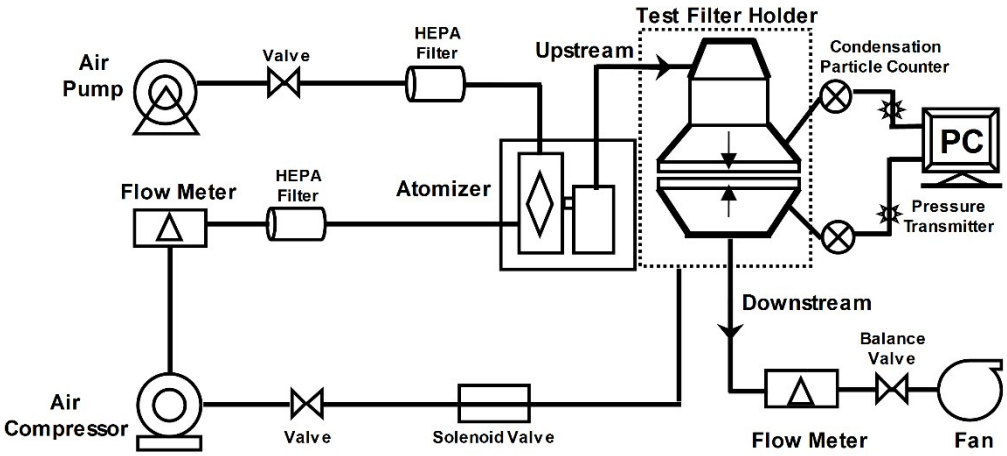
* Corresponding author. E-mail: binding@dhu.edu.cn; Phone: +86-21-62378202; Fax: +86-21-62378202

Filtration measurement of the fibrous media

The automated filter tester provided by Huada Filter Technology Co., Ltd., China is used to evaluate the filtration performance of the fibrous media. As shown in Scheme S1, the air compressor is used to supply the dilution air for the atomizer and the power for moving the tester filter holder. And, the solenoid valve is an automatic switch to control the running and stop of the holder. Based on the power supplied by the air pump and dilution air provided by the air compressor, the QRJ-1 NaCl atomizer can generate NaCl aerosol particles with diameter of 0.3-10 μm at a flow rate of 20-35 L/min. Additionally, the BCJ-1K laser condensation particle counter used here as a core instrument, can simultaneously measure both the particulate counts and the particulate size based on light scattering.

The membrane is clamped by a filter holder with circular cross section and effective area of 100 cm^2; then 300,000-500,000 charge neutralized monodisperse solid sodium chloride (NaCl) aerosol particles with mass mean diameter of 300-500 nm and geometric standard deviation <1.86, are delivered through the membrane. Thus, the filtration efficiency is accurately calculated by detecting the number of NaCl particles in the upstream and downstream of the airflow through the two laser particle counters, while the air resistance can be measured by two electronic pressure transducers that can detect the air pressure before and after the filter under a controlled airflow speed which can be adjusted with purpose between 20 and 100 L min^{-1}.

To measure the dust-holding capacity of the filters, the membranes are clamped by the aforementioned filter holder and tested under the airflow speed of 32 L min^{-1}, as it is usually regarded as the industrial standards flow rate in air filtration. However, the testing particles are substituted by the hydrophobic silicon dioxide nanoparticles in the size range of 4-70 nm to shorten the testing time, and the atomizer is substituted by a metal circular groove. The silicon dioxide nanoparticles are evenly distributed in this groove and kept dry to avoid agglomeration by lamp heating; thus the particles can be delivered through the membrane by virtue of the negative pressure provided by the fan and balance valve. During the testing process, the upstream should be shut off immediately when the pressure drop reaches 1000 Pa. Therefore, the dust-holding capacity can be calculated by measuring the weight change of the media between the initial state and end-of-life of 1000 Pa. All tests are conducted at the room temperature of 25 ± 2 ^{o}C and the relative humidity of 50%.



Scheme S1 Schematic diagram of the experimental setup for evaluating the filtration performance of the filtration media.

Table S1 Compositions and properties of various electrospinning solutions

PA-6 （wt %）	**PMIA fiber (wt %)**	**Viscosity （cps）**	**Conductivity （mS cm^{-1}）**	**Surface tension （mN m^{-1}）**
5	0.5	40	3.92	39.75
7.5	0.5	104	4.40	39.63
10	0.5	325	4.79	39.51
12.5	0.5	510	5.39	39.40
15	0.5	1002	5.44	39.17
10	0	275	4.59	38.44
10	1	361	4.96	39.93
10	1.5	462	4.67	40.10
10	2	572	4.65	40.28
10	2.5	1093	4.64	38.64

Table S2 Pore size and porosity of PA-6/PMIA NFN membranes with various PMIA fiber concentrations

Samples	PMIA staple fiber concentration (wt %)	Mean flow pore size (μm)	Porosity (%)
PA-6/PMIA NFN membrane	0	0.26	70.2
	1	0.31	86.4
	2	0.32	91.3
	2.5	0.45	90.5