

Effectiveness of Common Fabrics to Block Aqueous Aerosols of Virus-like Nanoparticles

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SUPPORTING INFORMATION

Fabrics and Masks

A full list of fabrics and masks is given in the table below. N95 respirators were manufactured by 3M Company (Saint Paul, MN, USA). N95 respirators and surgical masks were donated by Lahey Hospital and Medical Center. ProCool Stretch-FIT Dri-QWick Sports Jersey Fabric and Zorb 3D Stay Dry Dimple Heavy Duty Fabric were manufactured by AKAS Textiles & Laminations and supplied by Wazoodle Fabrics. Scotchgard® was manufactured by 3M Company (Saint Paul, MN, USA). The 525 high thread count (HTC) pillowcase is from Macy's Hotel Collection and was purchased at Macy's. All other fabrics were generously donated by JOANN Fabrics and Crafts.

Table S1. List of fabrics and combination of fabrics for testing nanoparticle penetration.

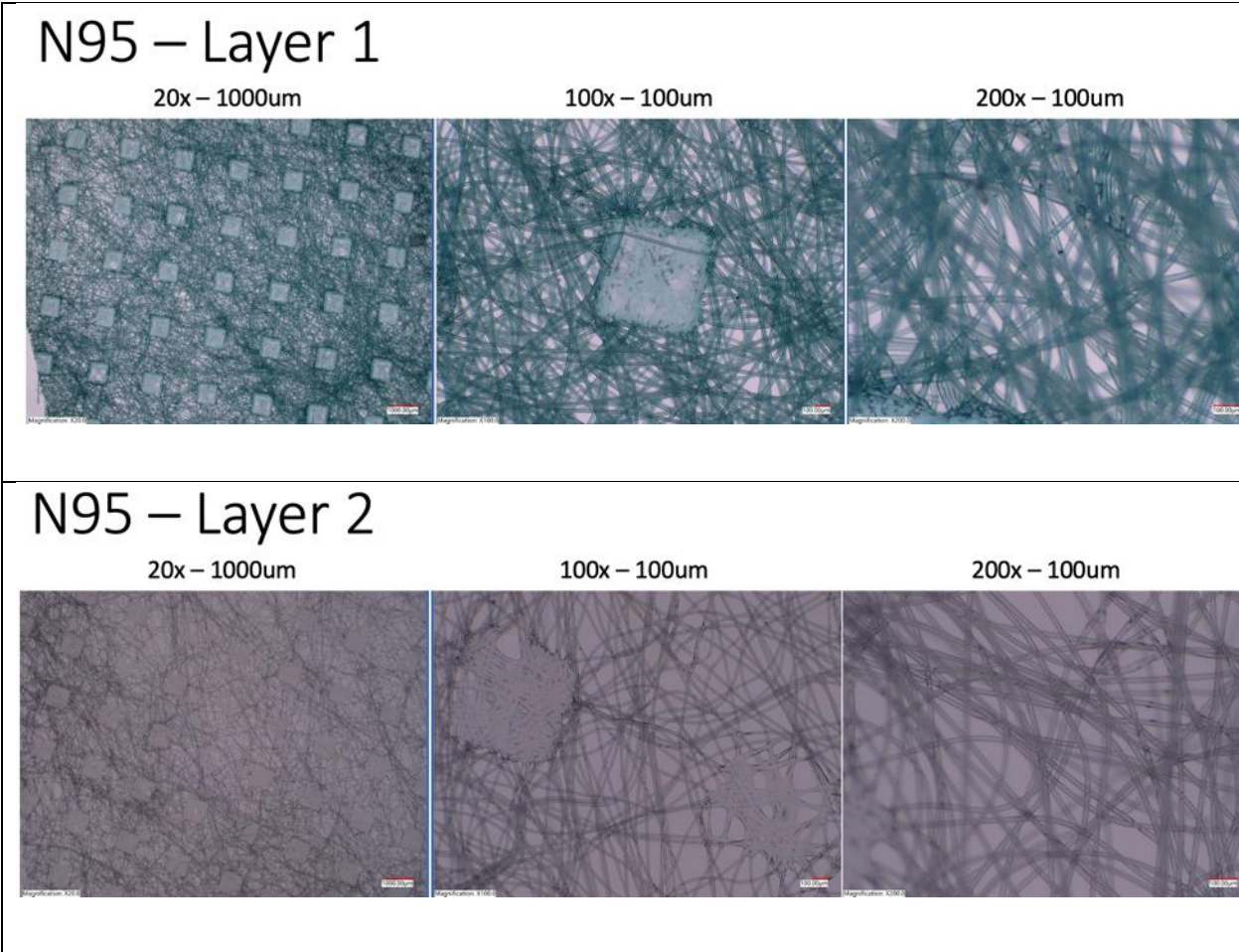
Materials and Material Combinations	Sample Description
N95 respirator: 3M 1860S (Lot# 15886)	5-layers https://www.3m.com/3M/en_US/company-us/all-3m-products/~3M-Health-Care-Particulate-Respirator-and-Surgical-Mask-1860S-Small-N95-120-EA-Case/?N=5002385+3294795977&rt=rud
N95 respirator: 3M 8200 (Lot# B18198)	3-layers https://www.3m.com/3M/en_US/company-us/all-3m-products/~3M-Particulate-Respirator-8200-

	07023-AAD-N95-160-EA- Case/?N=5002385+3294780149&rt=rud
KN95: 天一忠粮 (GB2626-2006KN95)	4-layers
Duck bill surgical mask: Halyard #37525	3-layers
Procedure mask: Cardinal Health™, #AT7509	1-layer
Kona (2-layers)	2-layers, 100 % cotton
Kona (3-layers)	3-layers
Kona (4-layers)	4-layers
Kona with Pellon Fusible Midweight #931TD	2-layers, Pellon 100% polyester
Kona (2-layers) with Pellon #P44F inner layer	3-layers, Pellon 100% polyester, ultra-lightweight
Kona (2-layers) with flannel inner layer	3-layers
Kona (2-layers) with 2-inner layers OLY-Fun	4-layers
Kona (2-layers) with 4-inner layers OLY-Fun	6-layers
Kona (2-layers) with Polartec® inner layer	3-layers, polyester Polartec® fleece
Kona (2-layers) with 2-inner layers terry cloth	4-layers
Kona (2-layers) with Scotchgard treated Kona inner layer	3-layers, 2.2 wt% treatment on Scotchgard® Kona inner layer
Kona / Flannel / OLY-FUN (2-layers) / Kona	5-layers

HTC pillowcase / Flannel / OLY-FUN (2-layers) / HTC pillowcase	5-layers, high tread count (HTC) pillowcase = 525 tread count, 100% cotton
OLY-Fun (2-layers)	2-layers, 100% polypropylene nonwoven, 65 GSM
Heavy T-shirt (1-layer)	1-layer, 100 % cotton
Heavy T-shirt (2-layers)	2-layers
Terry cloth towel (1-layer)	1-layer, 100 % cotton, 320 GSM
Terry cloth towel (2-layers)	2-layers
White Flannel Fabric (1-layer)	1-layer, 100 % cotton
White Flannel Fabric (2-layers)	2-layers
Denim – white (2-layers) with Pellon #931TD inner layer	3-layers
Light weight blue denim (2-layers)	2-layers, (1177-1615) 4 OZ LIGHT WASH DENIM
Midweight grey stretch denim (2-layers)	2-layers, (1673-4733) 7 OZ STRETCH DENIM GREY
Heavy weight black stretch denim (2-layers)	2-layers, (0161-7703) 11OZ BLACK STR DENIM
Kona (2-layers) with white denim inner layer	3-layers
Kona (2-layers) with 2-inner layers white denim	4-layers

White denim (2-layers) with 2-inner layers Kona®	4-layers
Sheldon G'S Face Mask with cellulose filter	4-layers, (2-layers) ProCool Stretch-FIT Dri-QWick Sports Jersey Fabric, Zorb 3D Stay Dry Dimple Heavy Duty Fabric ProCool Stretch-FIT Dri-QWick Sports Jersey Fabric

Table S2. Optical micrographs of fabrics.

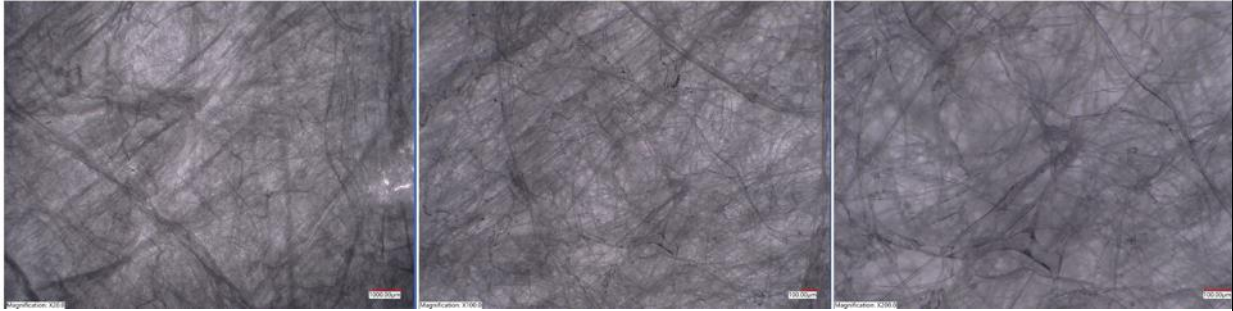


N95 – Layer 3 & 4

20x – 1000um

100x – 100um

200x – 100um

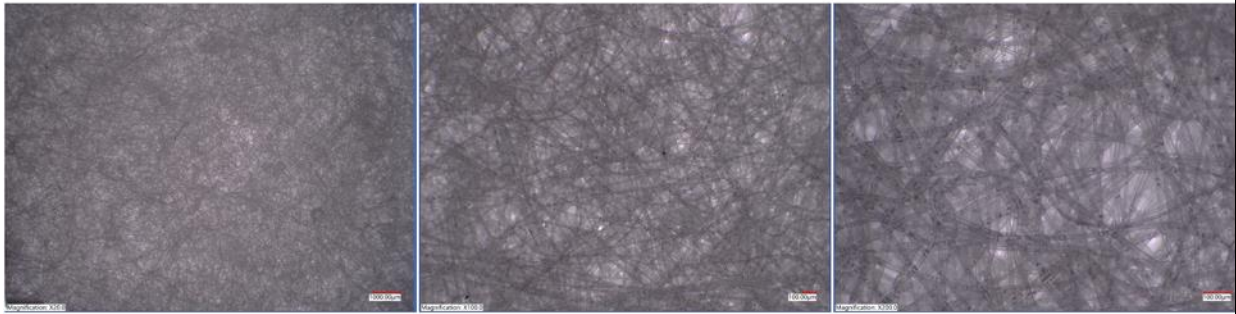


N95 – Layer 5

20x – 1000um

100x – 100um

200x – 100um

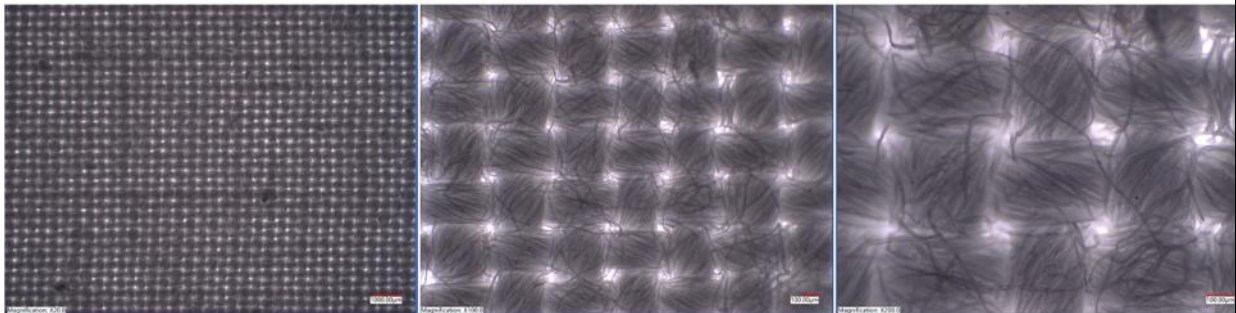


Kona quilting cotton

20x – 1000um

100x – 100um

200x – 100um

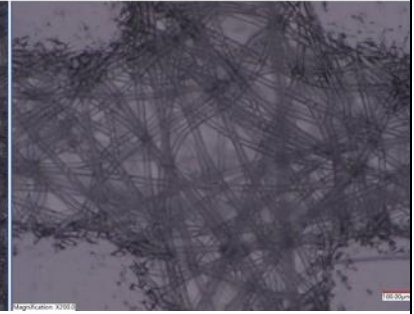
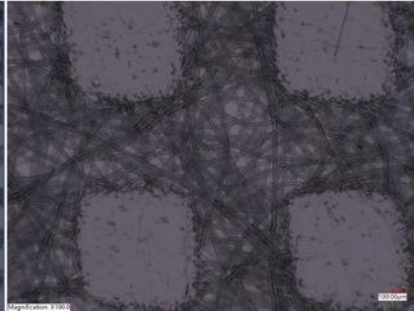
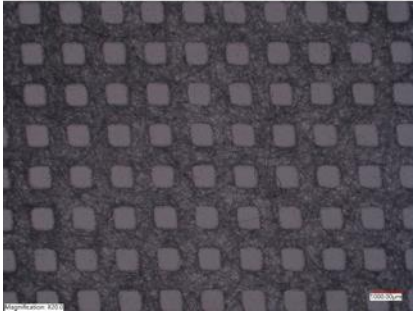


KN95 – Layer 1

20x – 1000um

100x – 100um

200x – 100um

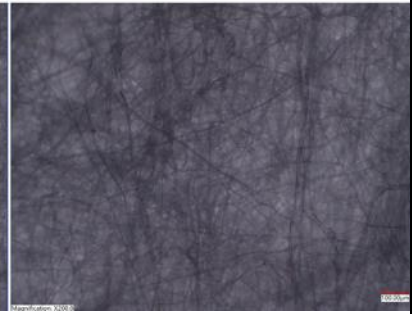
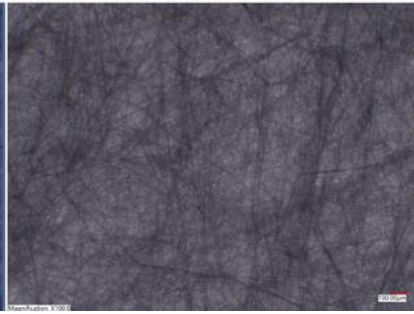
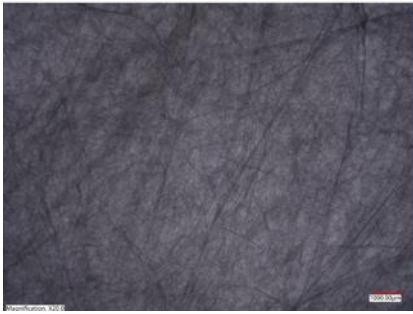


KN95 – Layer 2

20x – 1000um

100x – 100um

200x – 100um

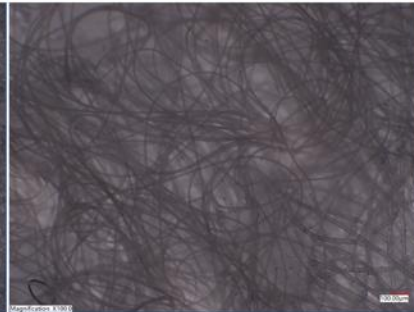
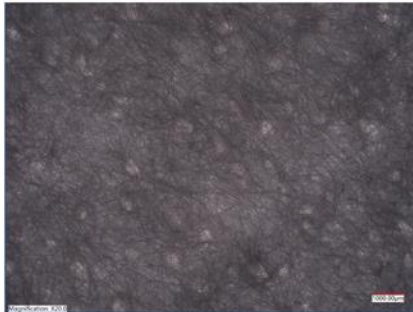


KN95 – Layer 3

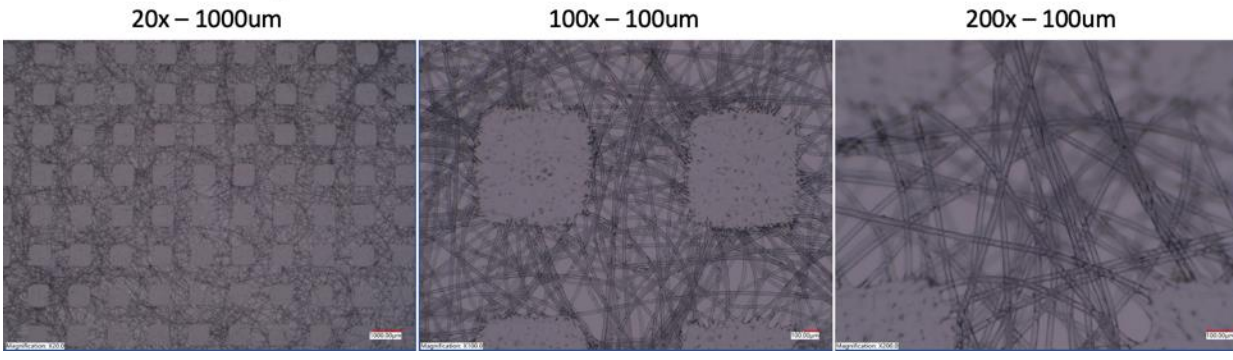
20x – 1000um

100x – 100um

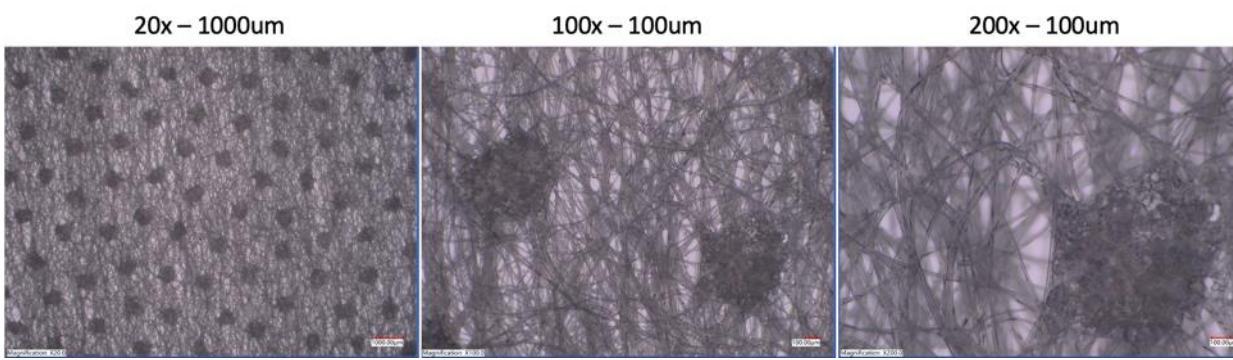
200x – 100um



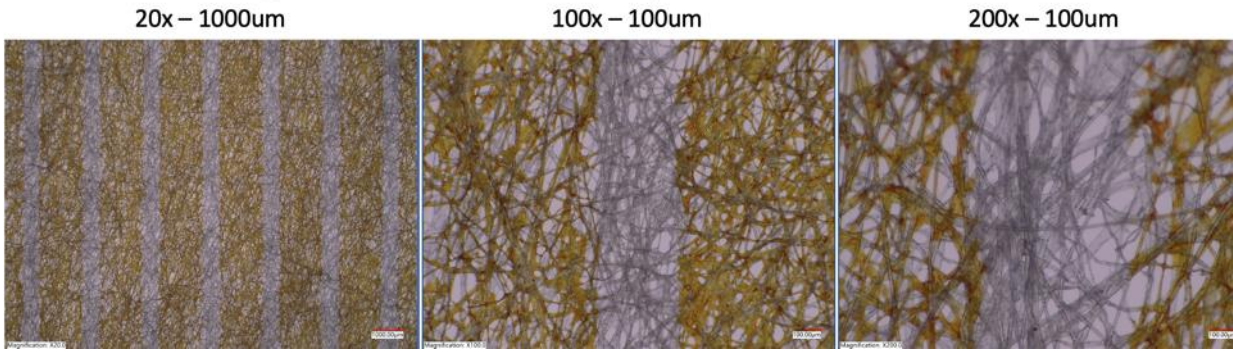
KN95 – Layer 4



Pellon 931TD



R25 – Surgical Mask – Layer 1

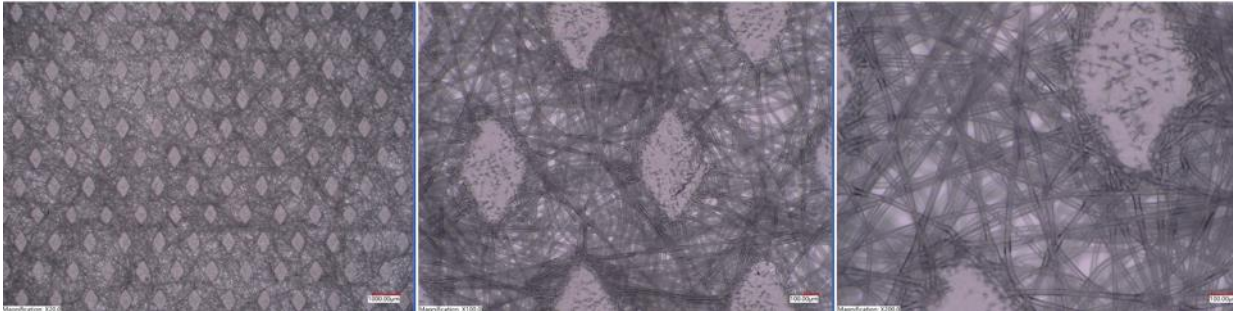


R25 – Surgical Mask – Layer 2

20x – 1000um

100x – 100um

200x – 100um

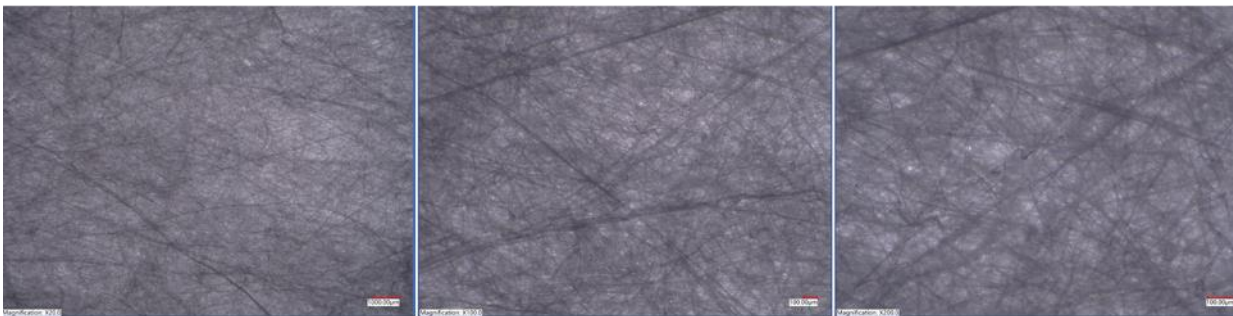


R25 – Surgical Mask – Layer 3

20x – 1000um

100x – 100um

200x – 100um

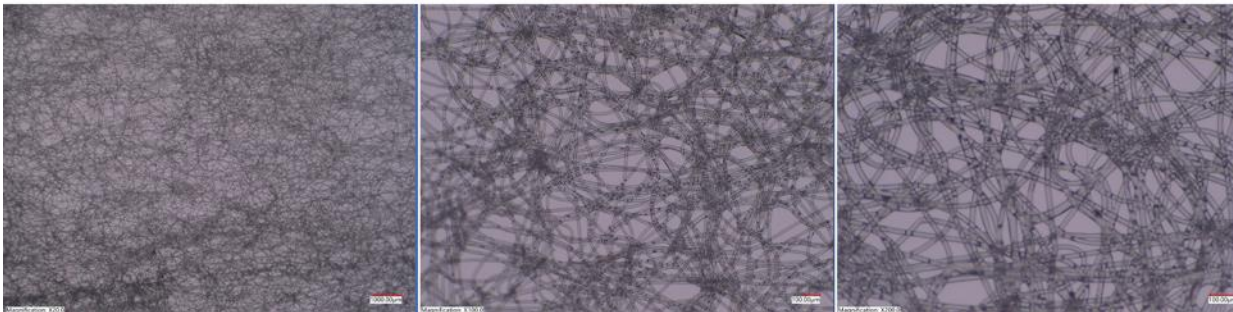


R25 – Surgical Mask – Layer 4

20x – 1000um

100x – 100um

200x – 100um



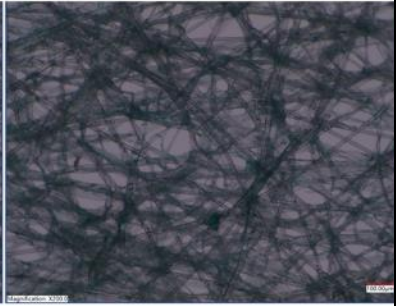
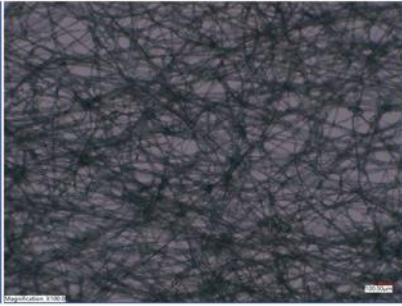
R33 – Surgical Mask

20x – 1000um

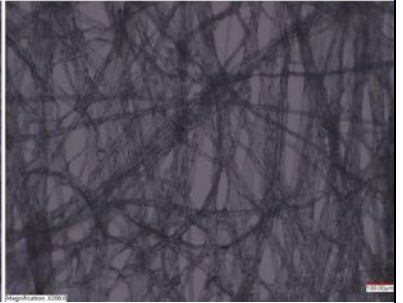
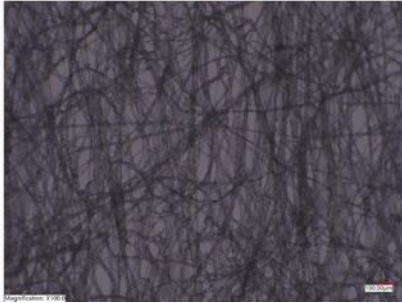
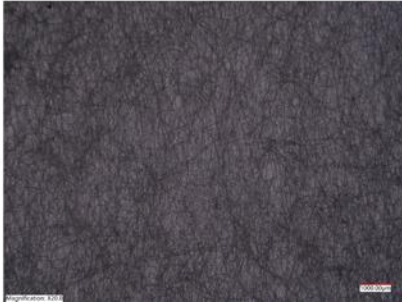
100x – 100um

200x – 100um

Layer 1



Layer 2

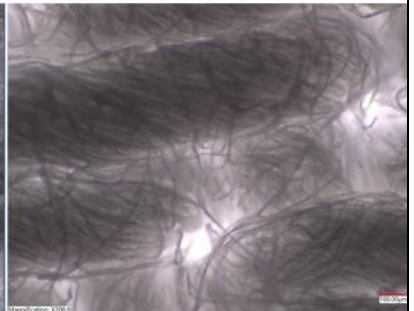
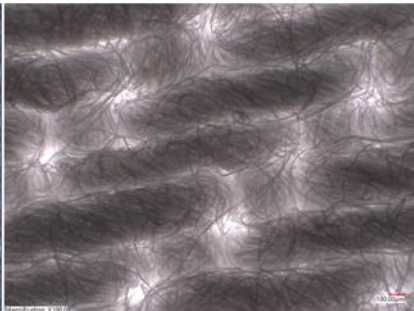
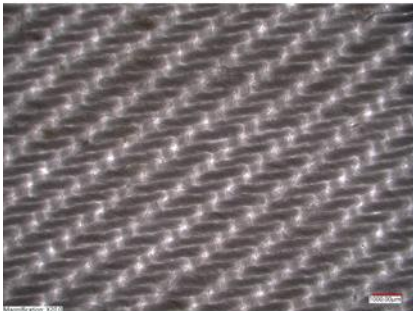


R23A – White Denim

20x – 1000um

100x – 100um

200x – 100um

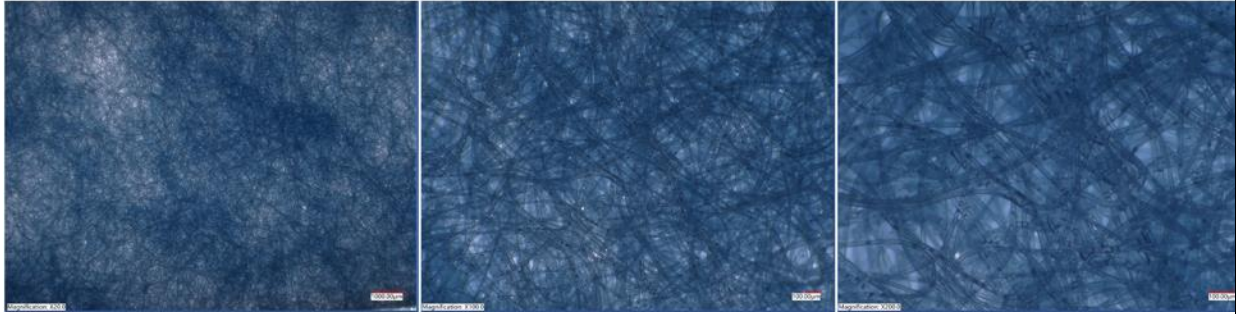


R34 – Duckbill Mask

20x – 1000um

100x – 100um

200x – 100um



R42 – Heavy Weight Black Stretch Denim

20x – 1000um

100x – 100um

200x – 100um



R43 – Midweight Blue Denim

20x – 1000um

100x – 100um

200x – 100um

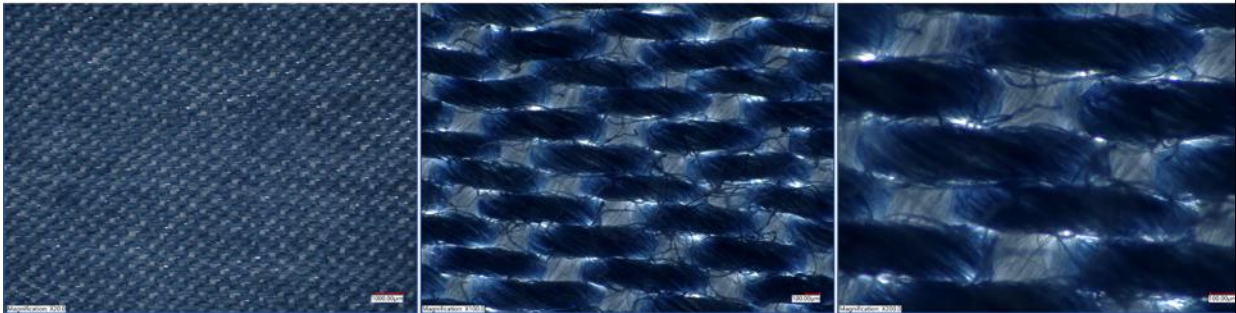


R45 – Light Weight Blue Denim

20x – 1000um

100x – 100um

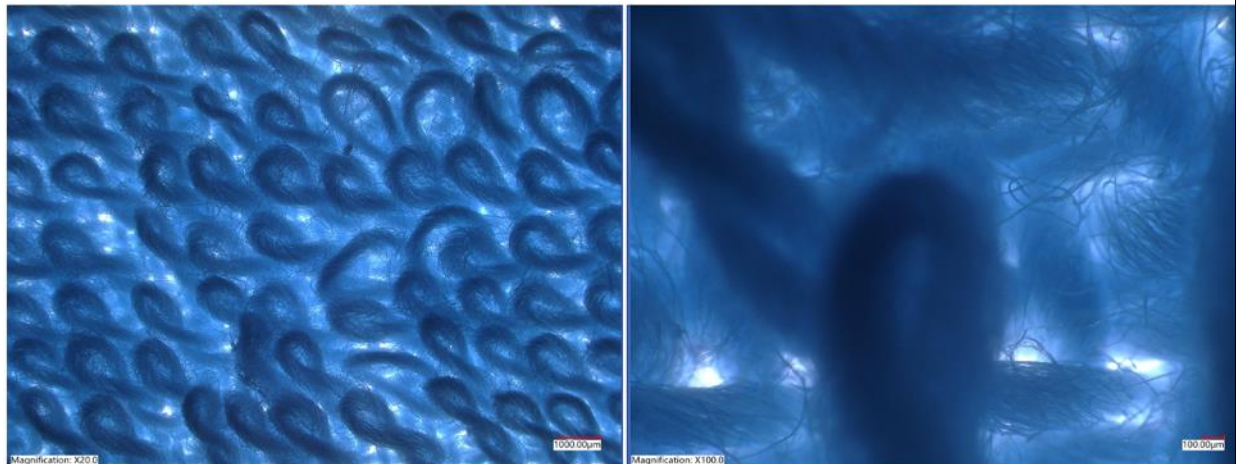
200x – 100um



Terry Cloth

20x – 1000um

100x – 100um



White Cotton Tee

20x – 1000um

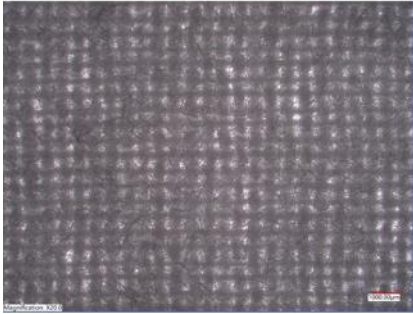
100x – 100um

200x – 100um

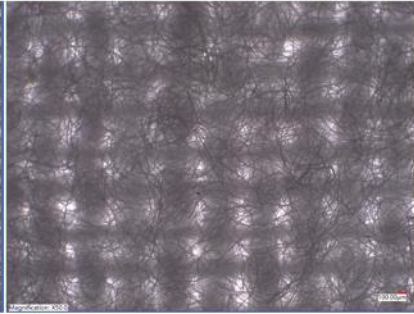


Flannel

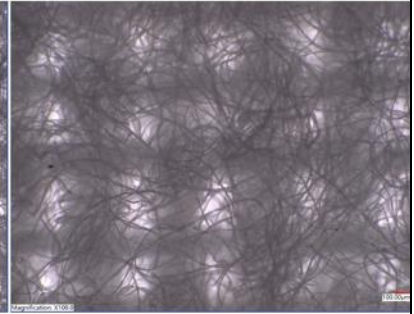
20x – 1000um



50x – 100um



100x – 100um



PolarTEC – Layer 1

20x – 1000um



100x – 100um



200x – 100um



PolarTEC – Layer 2

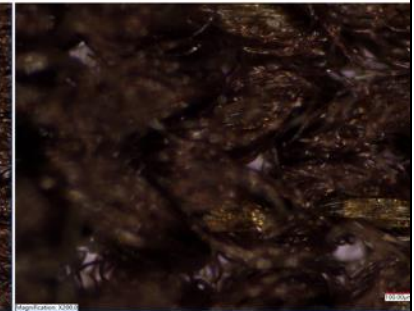
20x – 1000um



100x – 100um



200x – 100um

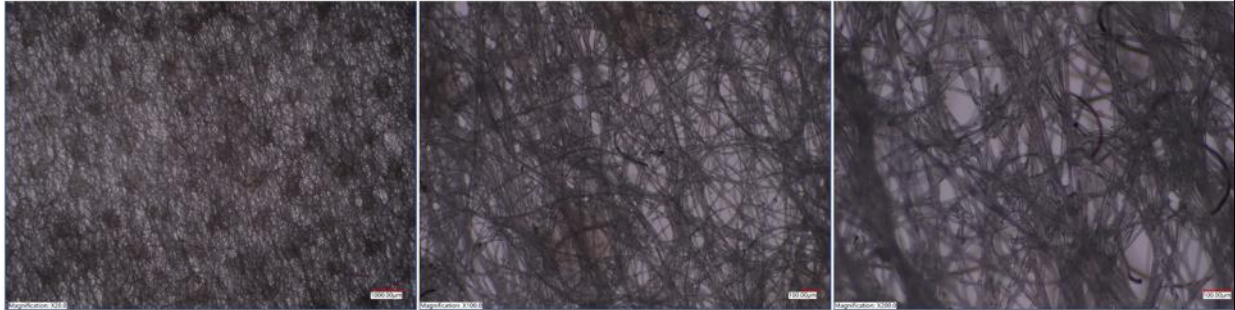


PolarTEC – Layer 3

20x – 1000um

100x – 100um

200x – 100um



Sheldon Outer Layer

20x – 1000um

100x – 100um

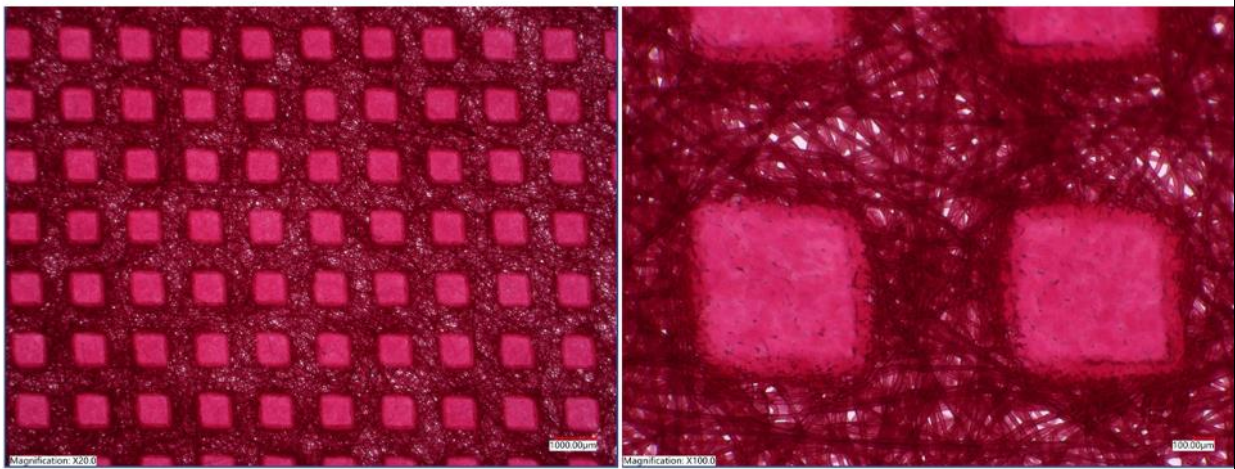
200x – 100um



OLY FUN

20x – 1000um

100x – 100um

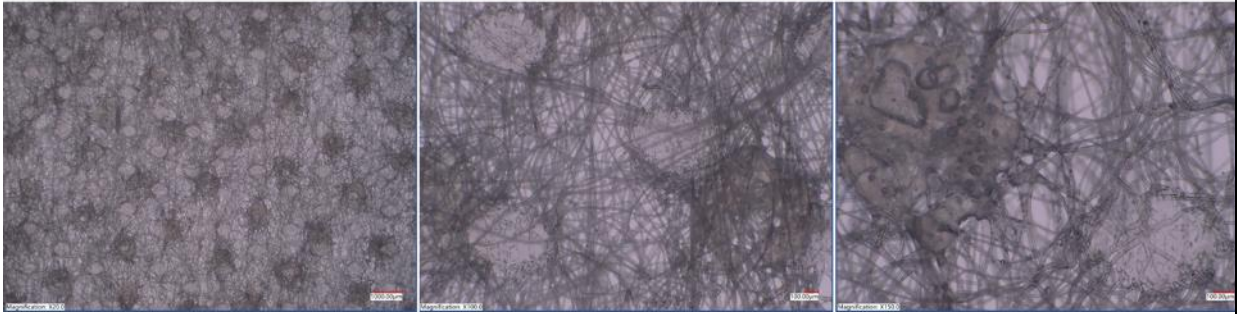


Pellon 845

20x – 1000um

100x – 100um

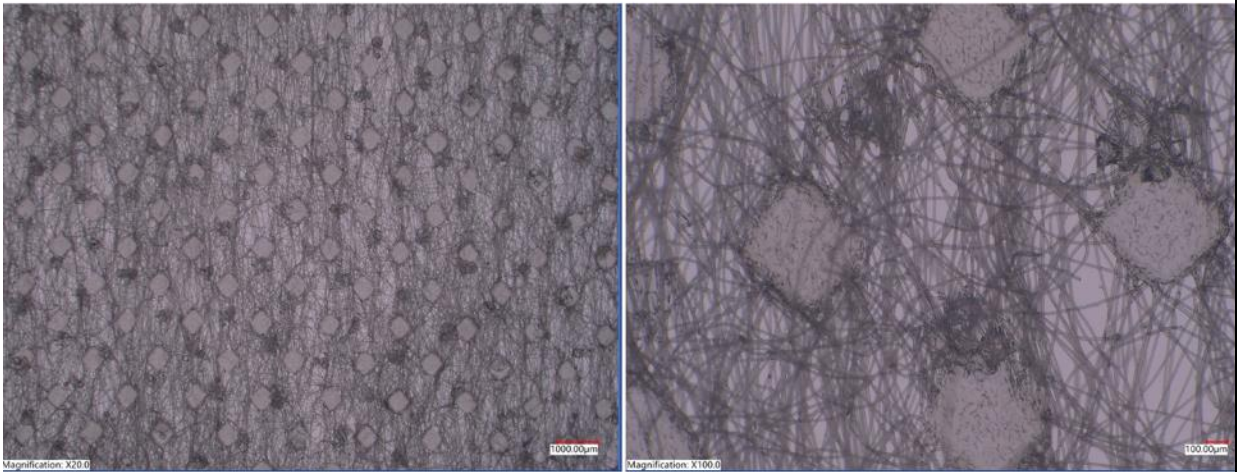
200x – 100um



Pellon P44F

20x – 1000um

100x – 100um



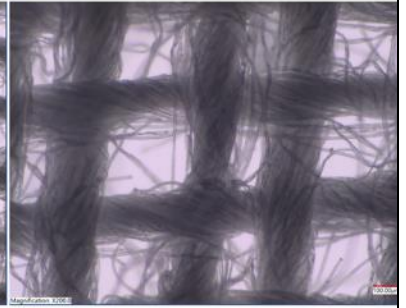
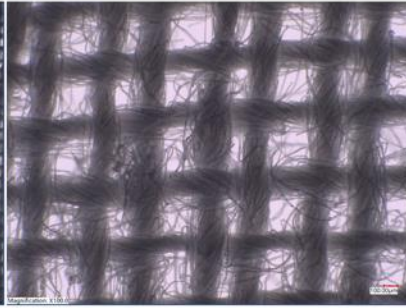
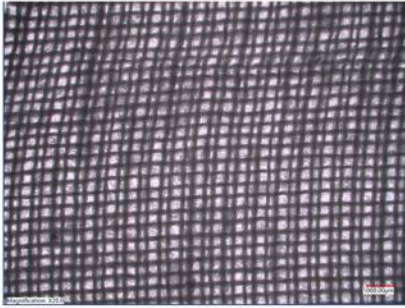
Pellon SF101

20x – 1000um

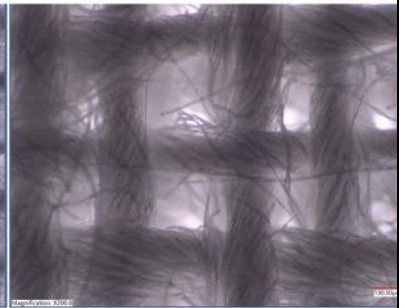
100x – 100um

200x – 100um

Non-ironed



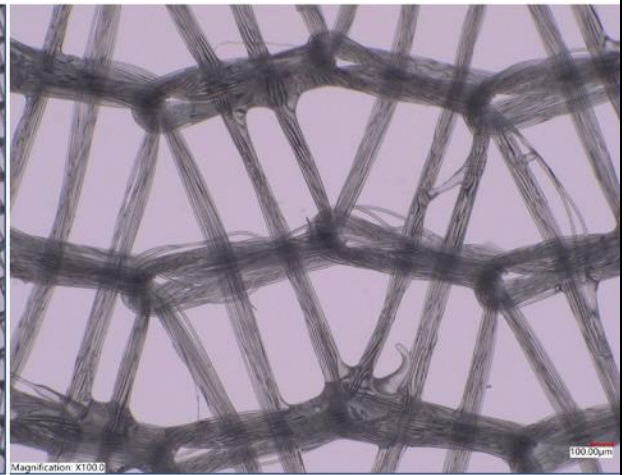
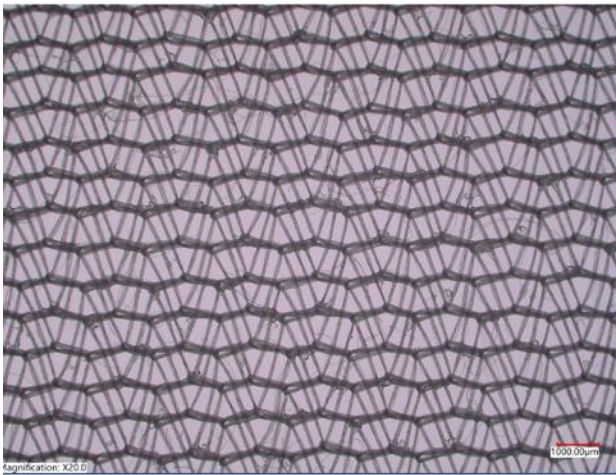
Ironed



Pellon SK135

20x – 1000um

100x – 100um

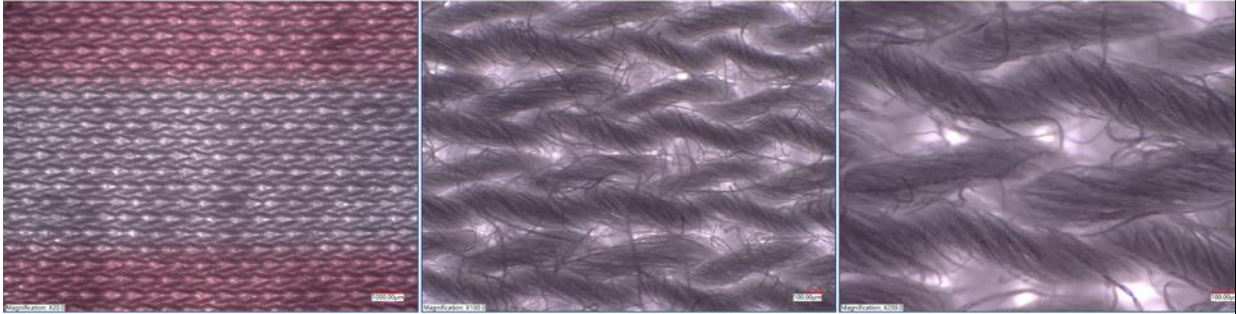


R11 – Cotton Tee

20x – 1000um

100x – 100um

200x – 100um



R47 – Poly-fil Extra-Loft Batting

20x – 1000um

100x – 100um

200x – 100um

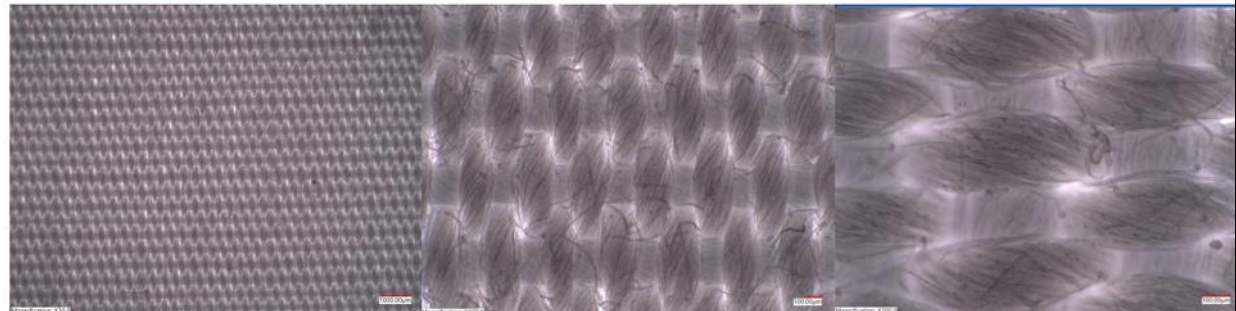


Lab Coat

20x – 1000um

100x – 100um

200x – 100um

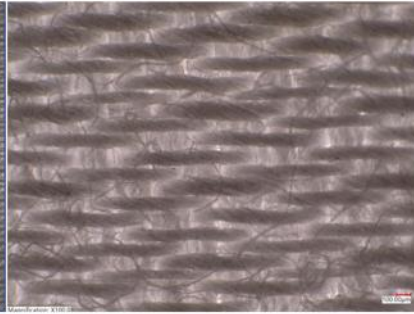


Pillow Case

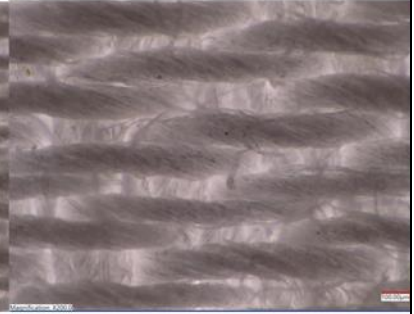
20x – 1000um



100x – 100um



200x – 100um



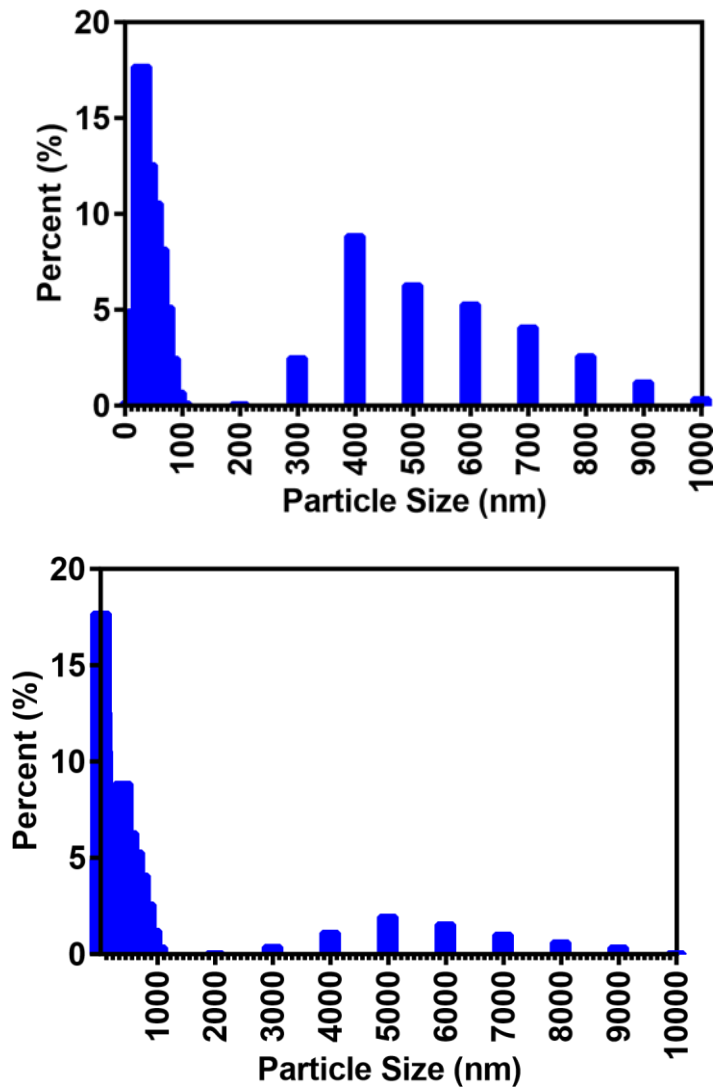


Figure S1. Variation in particle size diameter of as synthesized PLGA NPs. Average particle size is 460.4 nm and range from 10 nm to 10,000 nm. NP can be grouped into three buckets of 0-100 nm diameter, 100-1000 nm diameter, and 1000-10000 nm diameter NP, which encompass 62.01%, 30.76%, and 7.24% of all NP, respectively.

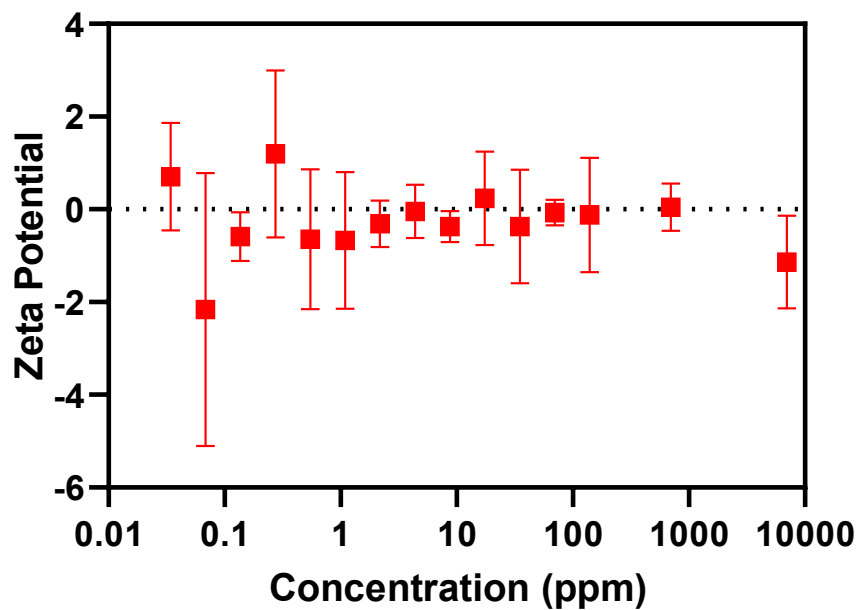


Figure S2. Variation in zeta potential measurements of the PLGA nanoparticle samples as a function of concentration. Inherent zeta potential was statistically zero for suspended nanoparticles independent of the concentration as it was varied from 7.0 mg/mL (1X) to 3.4×10^{-5} mg/mL (51200X).

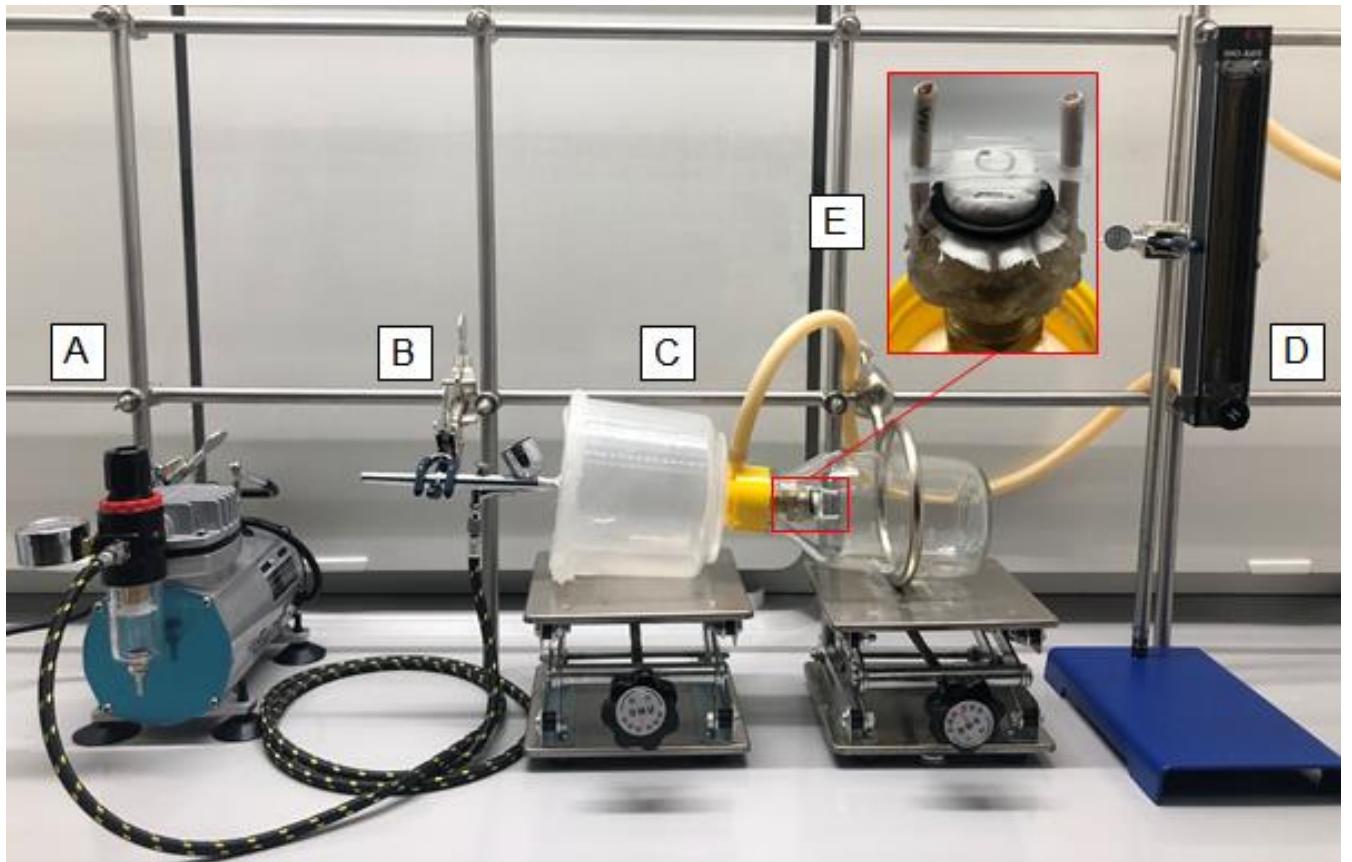


Figure S3. The complete test apparatus designed to transmit pressurized aerosol through material samples. The apparatus consists of (A) Master air compressor TC-20, (B) Master airbrush G22, (C) Bottle-top vacuum filter, (D) Sho-Rate rotameter #012. The close-up image (E) shows the positioning of the material sample and the marked glass slide within the bottle-top vacuum filter

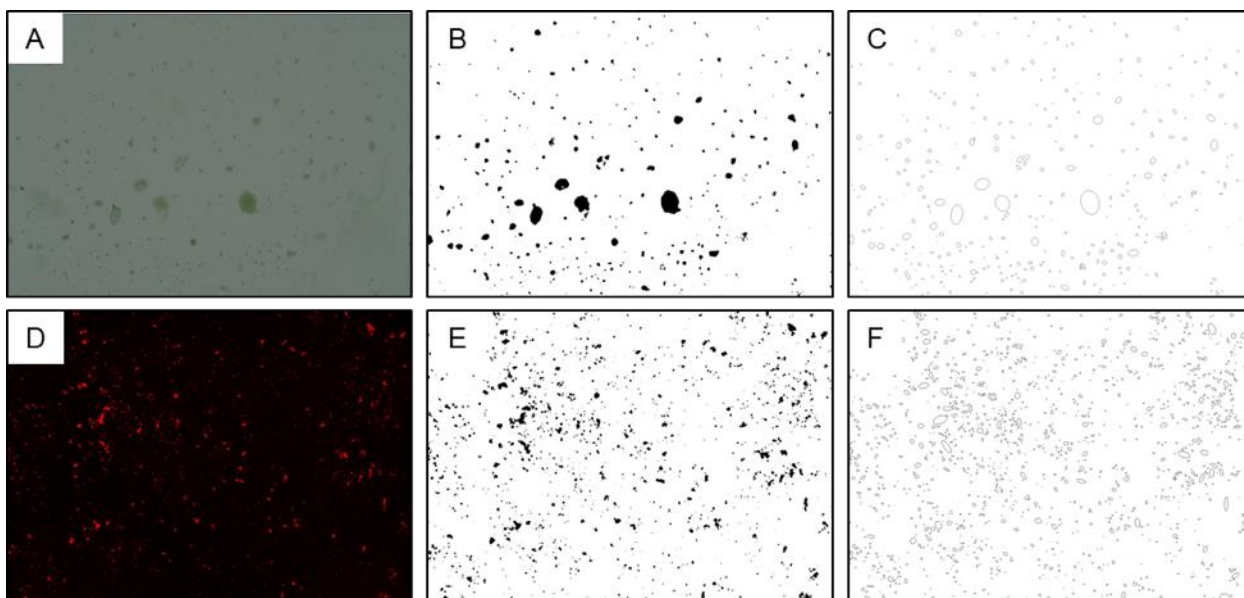


Figure S4. Representative images of droplet size distribution analysis (A-C) and nanoparticle distribution through fabric concentration analysis (D-F) in ImageJ image processing software. A raw image taken from the Keyence VHX-970F Optical Microscope was imported into ImageJ (A, D). The image's background was then removed followed by conversion into an 8-bit image and threshold adjustment (B, E). The final image was obtained by converting the 8-bit image into countable ellipse's using ImageJ's Analyze feature (C, F).

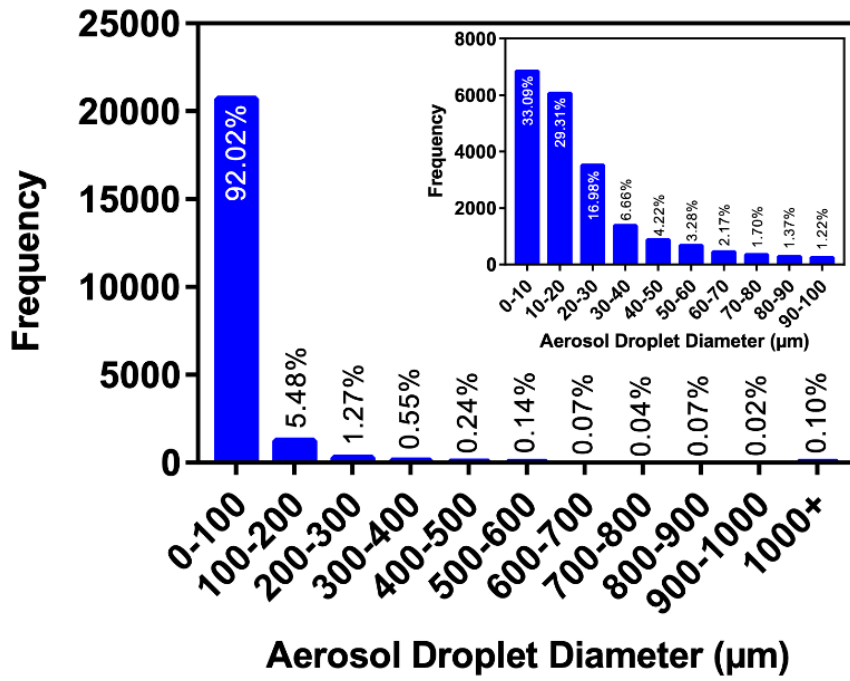


Figure S5. Measured aerosol droplet size distribution.