Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Supplementary Information for:

Non-woven materials for cloth-based face mask inserts: Relationship between material properties and sub-micron aerosol filtration

Leigh R. Crilley*, Andrea A. Angelucci, Brian Malile, Cora J. Young, Trevor C. VandenBoer, and Jennifer I. L. Chen*

Department of Chemistry, York University, Toronto, ON, Canada

*Corresponding Authors: jilchen@yorku.ca, lcrilley@yorku.ca

Supporting Experimental: Description of the material testing regime

A standard testing regime was followed over the day to minimize the impact of timing of sampling and nebulizer output. A summary of the sampling regime can be found in Table S1. At the start of each day of testing, the nebulizer was refilled to same level with our working solution and the output was allowed to stabilize for an hour to equilibrate prior to testing. During this time, we monitored the aerosol output with SMPS to ensure the consistent output was achieved prior to starting the materials testing. After one hour, the apparatus was cleaned and the nebulizer output was measured through the empty filter holder for three SMPS scans (15 mins) to determine the output particle number size distribution. After cleaning, the material sample was loaded into the filter holder and three SMPS scans measured (15 mins) to determine the particle number size distribution that pass through the material. At the completion of the material test, the apparatus was cleaned and the nebulizer output was checked through the empty filter holder (1 SMPS scan, 5 mins). This procedure of three measurement scans followed by an empty filter holder was repeated for the second and third test of the material (using a fresh sample each time) as per table S1. At the completion of the third test of the material, the nebulizer output was measured through an empty filter holder for three scans (15 mins) to ensure the output did not vary considerably from the start of testing. The filter holder and SMPS impactor were cleaned thoroughly between each test (material and empty filter holder) using a damp Kimwipe between negative control and material tests to ensure no bias from a buildup of NaCl. Furthermore, after completion of the testing regime, the SMPS was sampled via a HEPA filter to purge the SMPS system of any buildup of particles prior to starting the next set of material testing.

Table S1. Summary of a material testing regime. The elapsed time indicates the start time, includes the total time for SMPS measurement (5 mins per scan), along with typical times for cleaning and resetting the apparatus.

Elapsed time (mins)	Measurement	No. of SMPS scans
0	Equilibrate nebulizer	12
65	Empty filter holder	3
85	Material testing 1	3
95	Empty filter holder	1
115	Material testing 2	3
125	Empty Filter Holder	1
145	Material testing 3	3
165	Empty filter holder	3
185	HEPA	12

SUPPORTING FIGURES

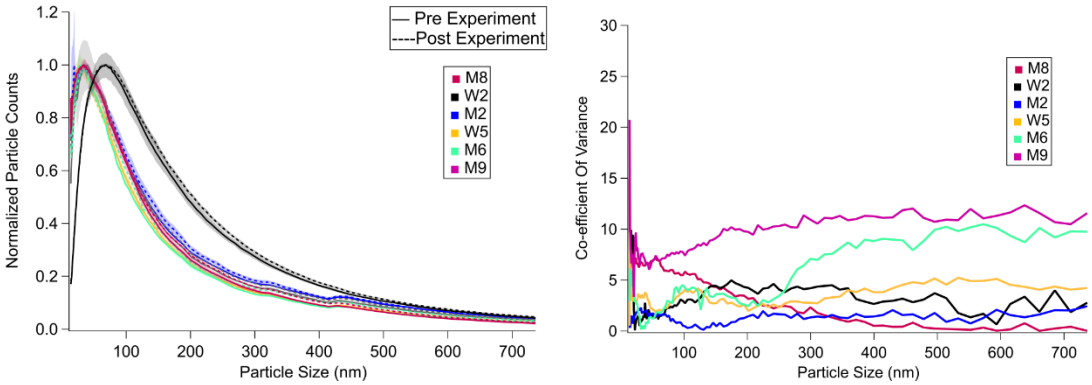

Figure S1. Variability of aerosol output shown as normalized particle counts vs size for pre- and post-material measurements in empty folder for selected materials (left) and co-efficient of variance for each material vs particle size (right). The different colours refer to different material tests.

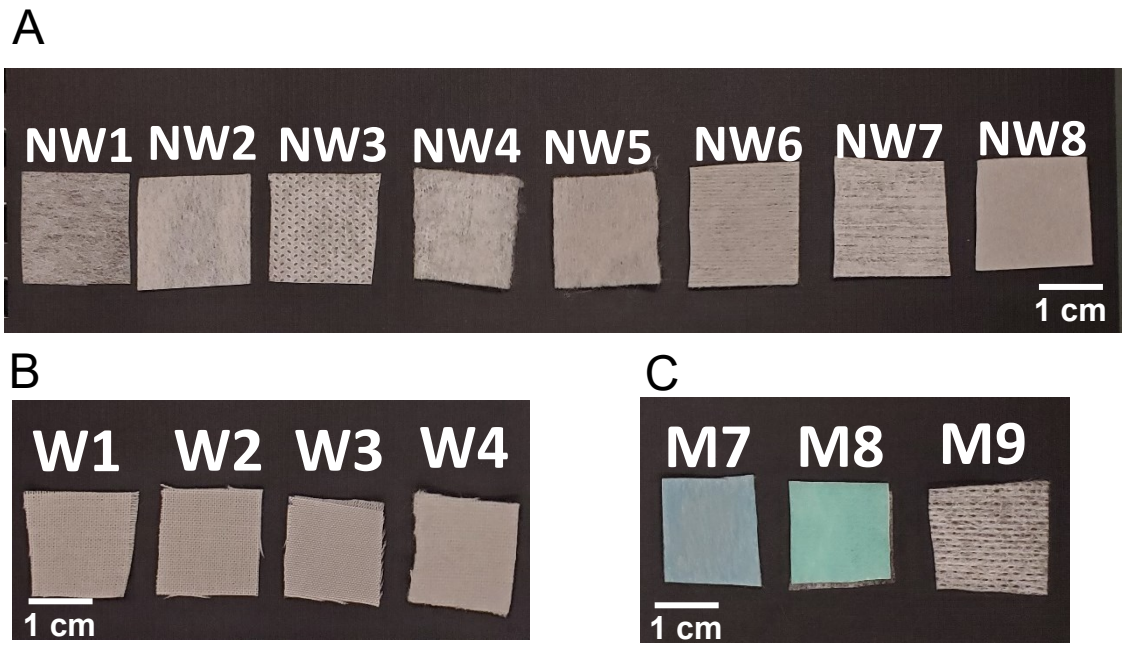

Figure S2. Photographs of the materials investigated: a) non-woven; b) woven; c) disposable masks and gauze. The materials ID are listed in Table 2.

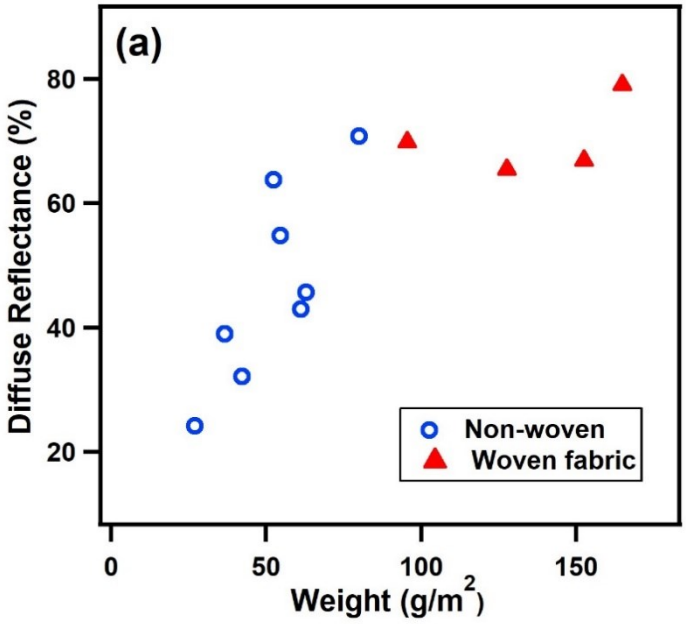

Figure S3. Diffuse reflectance measured at 700 nm vs weight of materials.

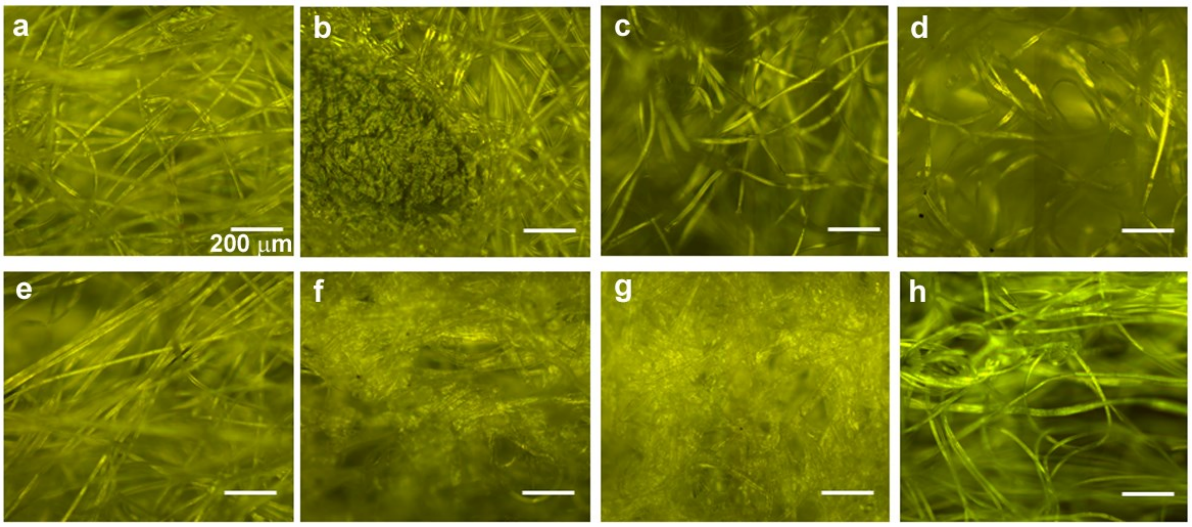

Figure S4. Reflectance images of non-woven material: (a) Interfacing; (b) Polypropylene; (c) Swiffer; (d) Baby wipe; (e) Rayon/polyester wipe; (f) Cellulose/polyester wipe; (g) ACL staticide wipe; (h) Gauze. Scale bar: 200 µm.

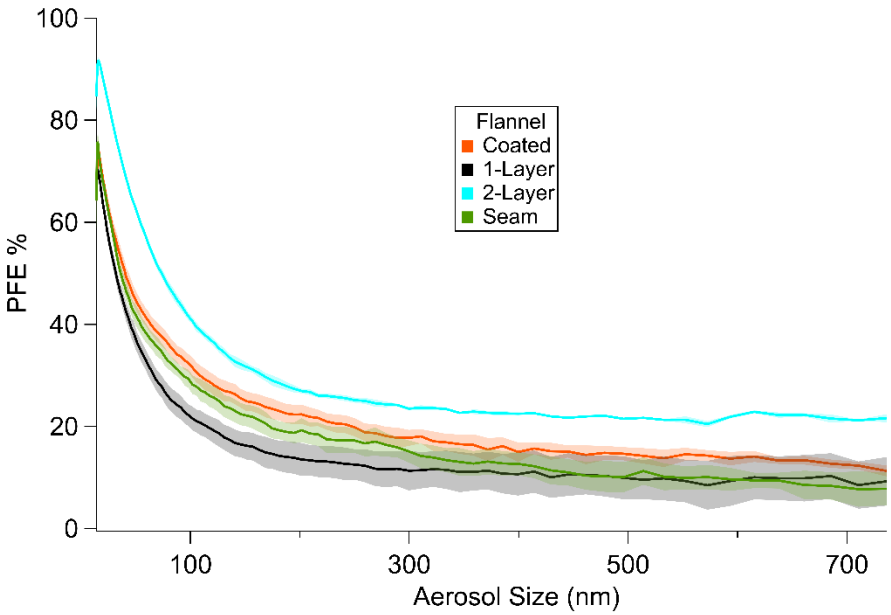

Figure S5. PFE as a function of aerosol size for flannel 1 and 2 layer(s), as well as with the seam and water-resistant treatment. Variability shown is one standard deviation of the mean for the three tests.

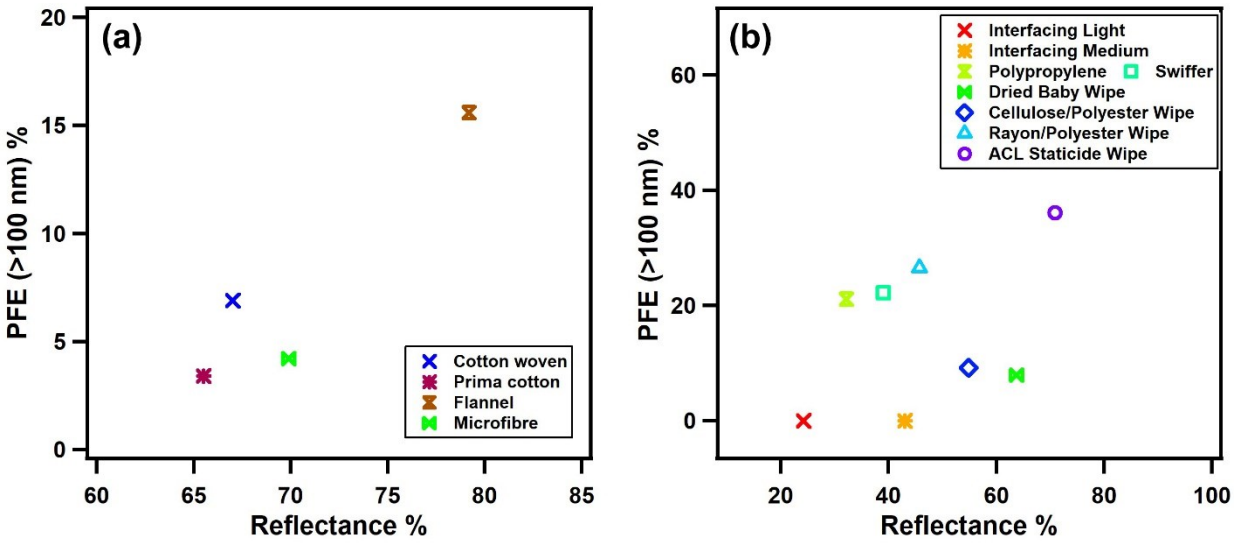

Figure S6. PFE vs diffuse reflectance at 700 nm for fabrics (a) and non-woven materials (b).

SUPPORTING TABLE

Table S2. Experimental and predicted values of PFE and Impedance for multilayer combinations.

ID	Material	Experimental $PFE_{>100\ nm}$ (%)	Predicted $PFE_{>100\ nm}$[a] (%)	Experimental Impedance (mbar/(cm/s))	Predicted Impedance[b] (mbar/(cm/s))
M1	Prima cotton 2 layer	8.9	8.4	0.08	0.08
M2	Woven cotton 2 layer	12.6	13.3	0.09	0.08
M3	Flannel 2 layer	30.5	28.8	0.1	0.08
M4	Flannel/PP/Flannel	49.0	43.8	0.12	0.12
M5	WR-flannel/Swiffer/Flannel	40.4	49.9	0.15	0.1
M6	Flannel/Rayon/Flannel	48.7	47.7	0.09	0.09

[a]Using equation 5.
[b]Based on the sum of individual layer's impedance.