Supporting Information

Core-shell nanofibrous materials with high particulate matter removal efficiencies and thermally-triggered flame retardant properties

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Experimental Procedures

Materials synthesis and fabrication.

To fabricate the TPP@Nylon-6 fiber by electrospinning, TPP (Sigma-Aldrich) and Nylon-6 (Sigma-Aldrich) were dissolved in formic acid (Baler Analyzed) with a concentration of 10 wt% and 20 wt%, respectively. A transparent solution was obtained by vigorous stirring. Then the solution was placed into a syringe with a stainless-steel needle. We used a commercial high-voltage source (Gamma High Voltage Research, model ES-30P-5W) for electrospinning. The solution was pumped out of the needle tip using a syringe pump (KD Scientific) and ejected to the rough side of the commercial copper foil (Pred Materials), which was grounded to collect electrospun nanofibers. The applied potential was 15 kV, the pump rate was 0.06 ml/h and the needle-collector distance was 15 cm.

Characterization.

SEM were taken on an FEI XL30 Sirion. X-ray photoelectron spectroscopy (XPS) was carried out on SSI S-Probe Monochromatized, Al Kα radiation at 1486 eV. TGA was performed on a TA Instrument Q500 with a heating rate of 5.00 °C/min. The measurement was performed under simulated air atmosphere (20% O_2 + 80% Ar). DSC was measured on TA Instrument Q2000 with a heating rate of 5.00 °C/min under nitrogen.

Optical transmittance measurement. The transmittance was measured used a xenon lamp (69911, Newport) as the light source, coupled with a monochromator (74125, Newport) to control the wavelengths. An iris was used to trim the beam size to ~5 mm×5 mm before entering an integrating sphere (Newport) for the transmittance measurements. A photodetector (70356, Newport) was inserted into one of the ports of integrating sphere. The photodiode is connected to lock-in radiometry system (70100 Merlin, Newport) for photocurrent measurements. The samples were placed in front of the integrating sphere; therefore, both specular transmittance

and diffuse transmittance were included. For air filters composed of nanofiber film and mesh, a clean mesh with the same geometry was used as a reference. The transmittance spectrum was then weighted by AM1.5 solar spectrum from 400 to 800 nm to obtain the average transmittance.

PM generation and efficiency measurement. The PM particles were generated from by burning incense. The incense smoke PM particles have a wide size distribution from <300 nm to >10 μm, with the majority of particles being <1 μm. The inflow concentration was controlled by diluting the smoke PM by air to a hazardous pollution level equivalent to the PM2.5 index >300. PM particle number concentration was detected with and without filters by a particle counter (CEM) and the removal efficiency was calculated by comparing the number concentration before and after filtration. The pressure drop was measured by a differential pressure gauge (EM201B, UEi test instrument). Unless mentioned, the wind velocity used in the efficiency test was 0.5 m/s and the humidity was 30%.

Flame retardant properties testing. For the testing of the flame retardant properties in Figure 4, the filters was wetted by preweighed vegetable oil (~0.2 g) and vertically mounted, then ignited by a lighter. The lighter was removed as the filter started to combust.

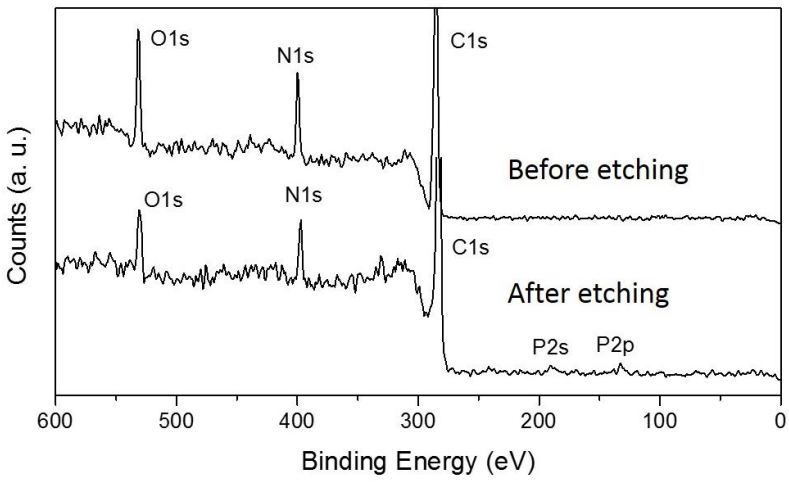

Figure S1 XPS of the TPP@Nylon-6 air filter before and after etching.

Figure S2 A digital photo of the TPP reagents, showing that the TPP are prone to form flake-like crystals.

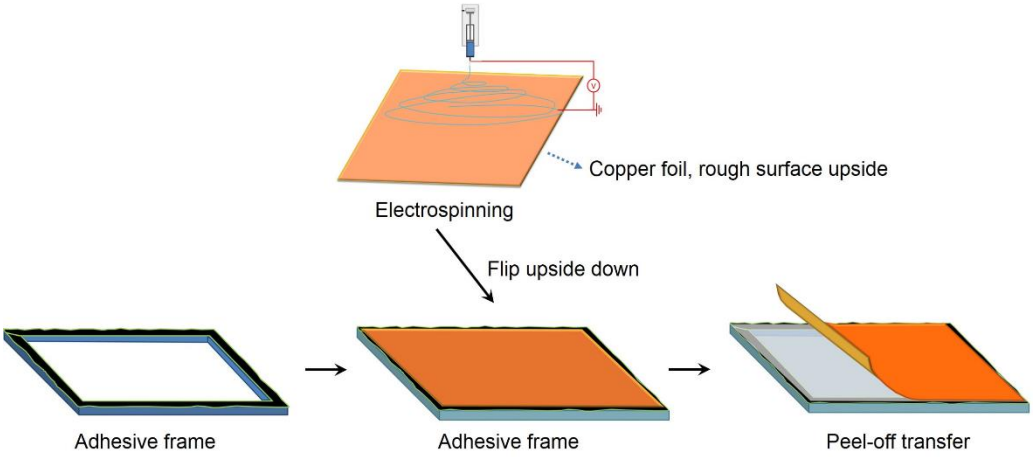

Figure S3 Schematic showing the transfer of freestanding electrospun nanofiber film.

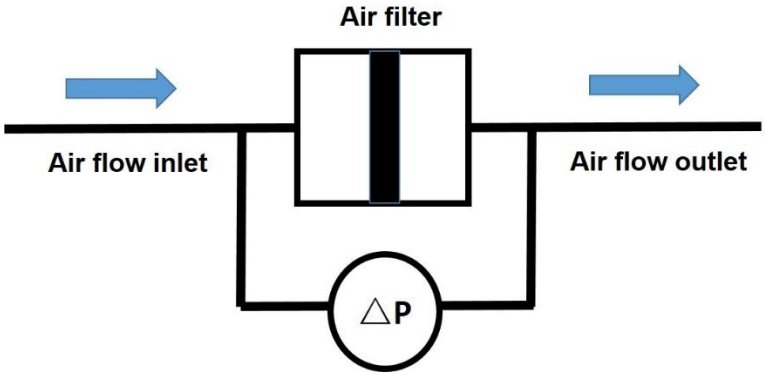

Figure S4 Schematic set-up for the measurement of the air pressure difference across the air filter, i. e. pressure drop (DP).

Sample	T(%)	E(%)	DP(Pa)	QF (Pa^{-1})
TPP@Nylon 6	80	99.06	253	0.01822
Commercial-1	15	16.93	299	0.00062
Commercial-2	6.2	99.58	809	0.0068

Table S1 Performance summary of TPP@Nylon-6 flame retardant air filters compared with commercial air filters.

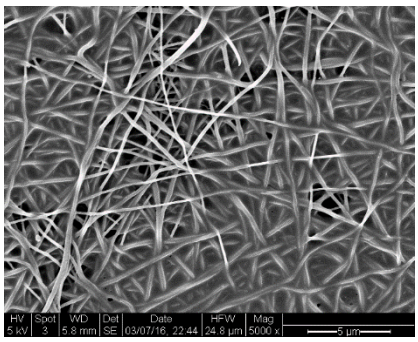

Figure S5 SEM of the TPP@Nylon-6 air filter after long term filtration.

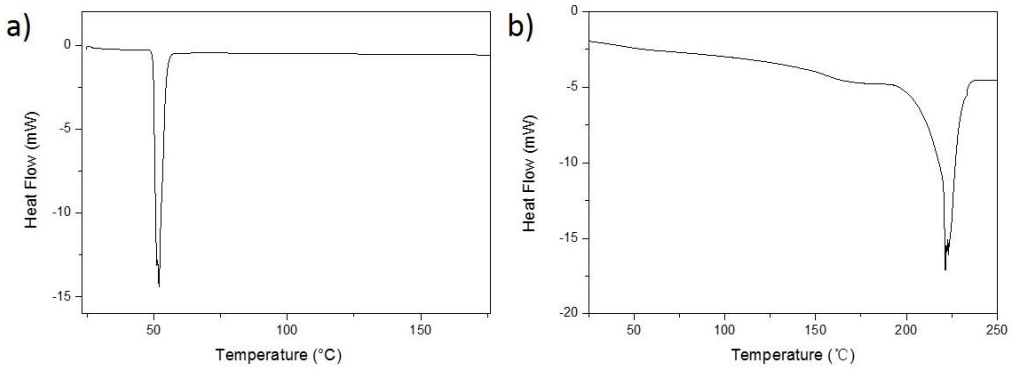

Figure S6 DSC curves of the a) TPP and b) Nylon-6.