Supplementary Information

Efficient capture of $PM_{2.5}$ by intertwined tubular conjugated microporous polymers-based filters with high stability in humidity environment

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Characterization

The morphology of the CMPs was taken on Scanning electron microscope (SEM JSM-6701F) and Transmission electron microscope (TEM Tecnai G2TF20). The morphology of the samples was taken on scanning electron microscope (TESCAN MIRA3) equipped with an energy dispersive spectroscopy (EDS) under a vacuum environment. The specific surface area and porosity of the as prepared CMPs was measured by N2 adsorption and desorption at 77.3 k using a volumetric sorption analyzer (micromeritics ASAP 2020). Before analysis, the samples were degassed at 120 ℃ for 12 h under vacuum. XPS spectra were measured using a Physical Electronics 5000 Versa Probe II Scanning ESCA (XPS) Microprobe. The X-ray diffraction (XRD) was performed on a RigakuD/Max-2400 diffractometer with 2θ at 2° to 80°. Water contact angle (CA) measurement was performed on a contact angle meter OCA20 (Dataphysics, Germany). The visualization of the sample was recorded by Photons Fastcam Mini UX100 type high speed video camera. TGA analysis was carried out using a STA 6000 (PerkinElmer Instrument Co., Ltd. USA) to investigate thermal stability of the samples over a temperature range of 25 to 800 °C at a rate of 5 °C min^{-1} under N_2 atmosphere. The mechanical properties of samples were measured using a universal testing machine (CMT4304, Shenzhen SANS Test Machine Co. Ltd., Shenzhen, China) equipped with a 50 N load cell at room temperature. The tests were performed with a gauge length of 50 mm and a loading speed of 10 mm min^{-1}.

PM removal test

The PM removal test was tested by the dust particle counter (CEM DT-9850M).

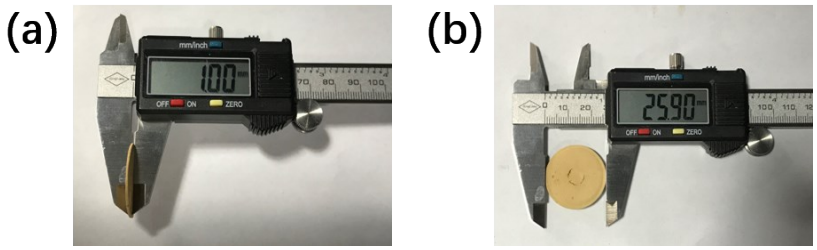

Figure S1. (a) Photograph of the thickness of a sample measured with a vernier caliper, showing the thickness of 1mm. (b) Photograph of the diameter of the sample measured with a vernier caliper, showing a diameter of 25.90mm.

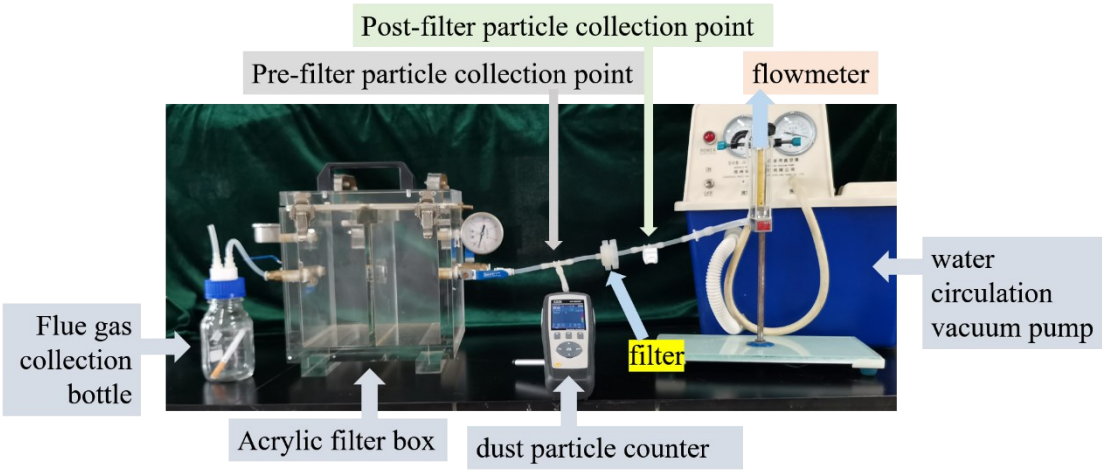

Figure S2. Physical photographs of the flue gas collection and filtration system.

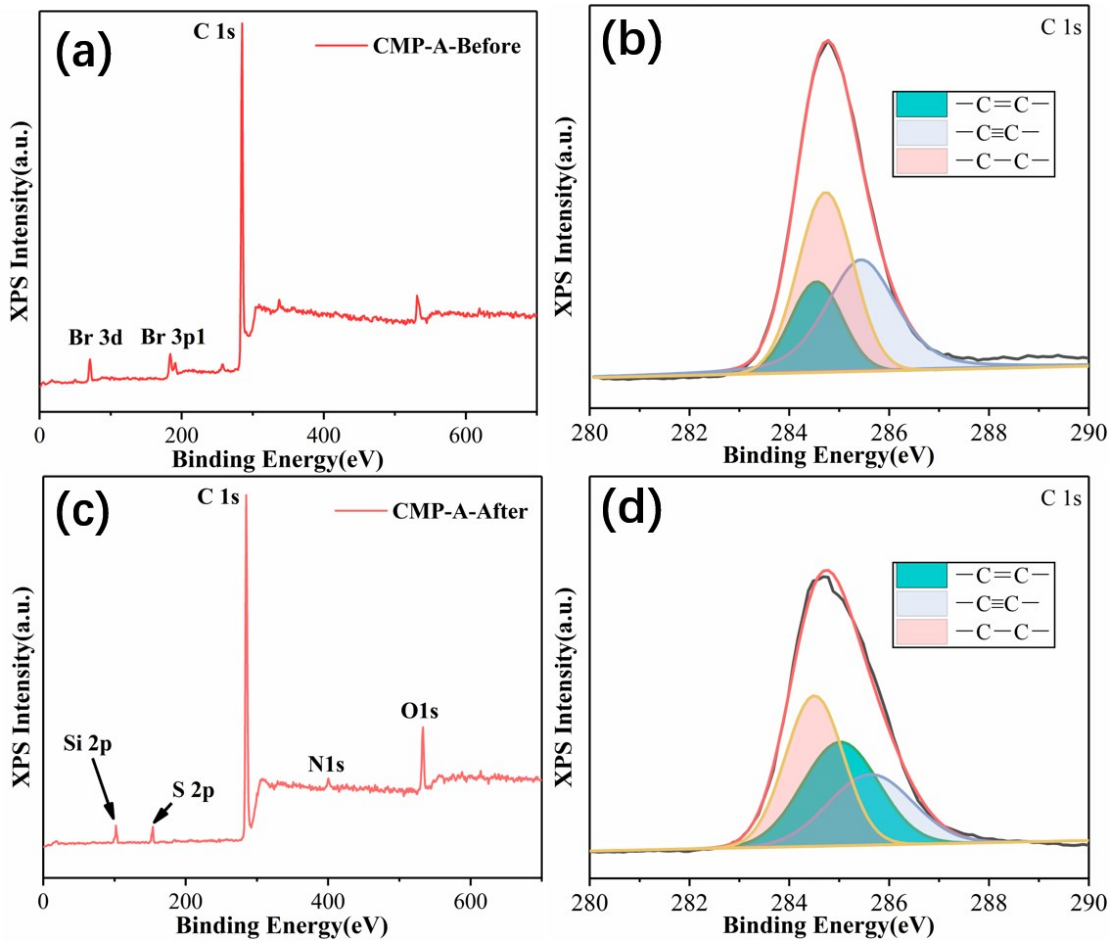

Figure S3. (a) The survey spectrum of CMP-As before filtration. (b) The C1s spectrum of CMP-As before filtration. (c) The survey spectrum of CMP-As after filtration. (d) The C1s spectrum of CMP-As after filtration.

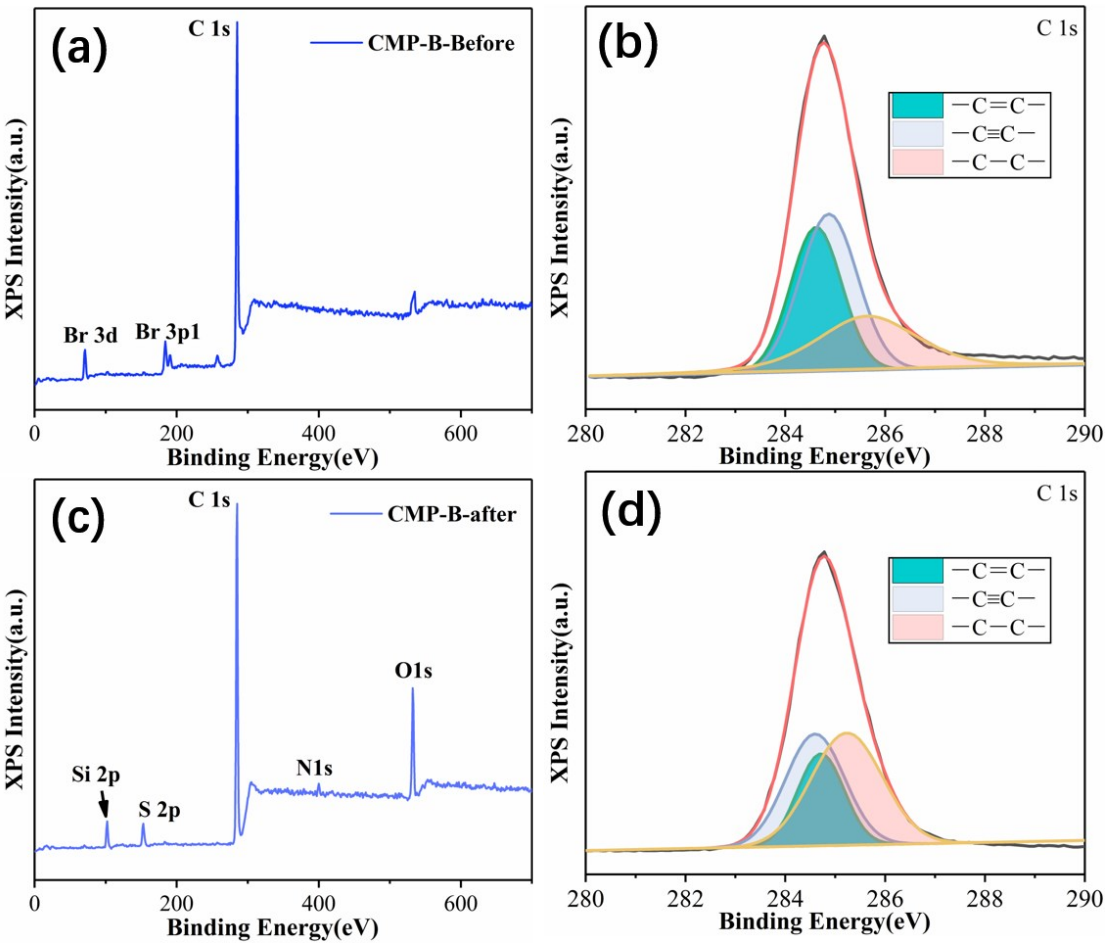

Figure S4. (a) The survey spectrum of CMP-Bs before filtration. (b) The C1s spectrum of CMP-Bs before filtration. (c) The survey spectrum of CMP-Bs after filtration. (d) The C1s spectrum of CMP-Bs after filtration.

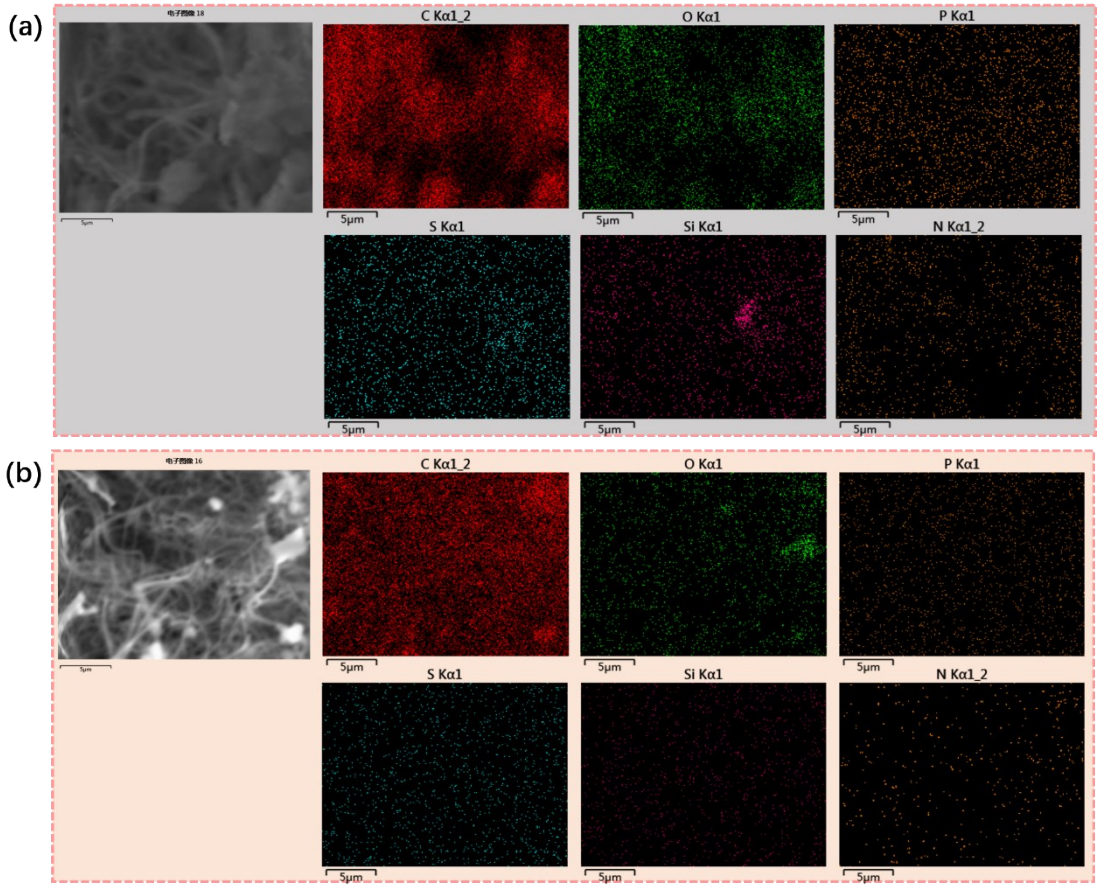

Figure S5. (a) EDS photographs of distribution of elements for C, O, P, S, Si and N on the surface of CMP-As after filtration. (b) EDS photographs of distribution of elements for C, O, P, S, Si and N on the surface of CMP-As after washing.

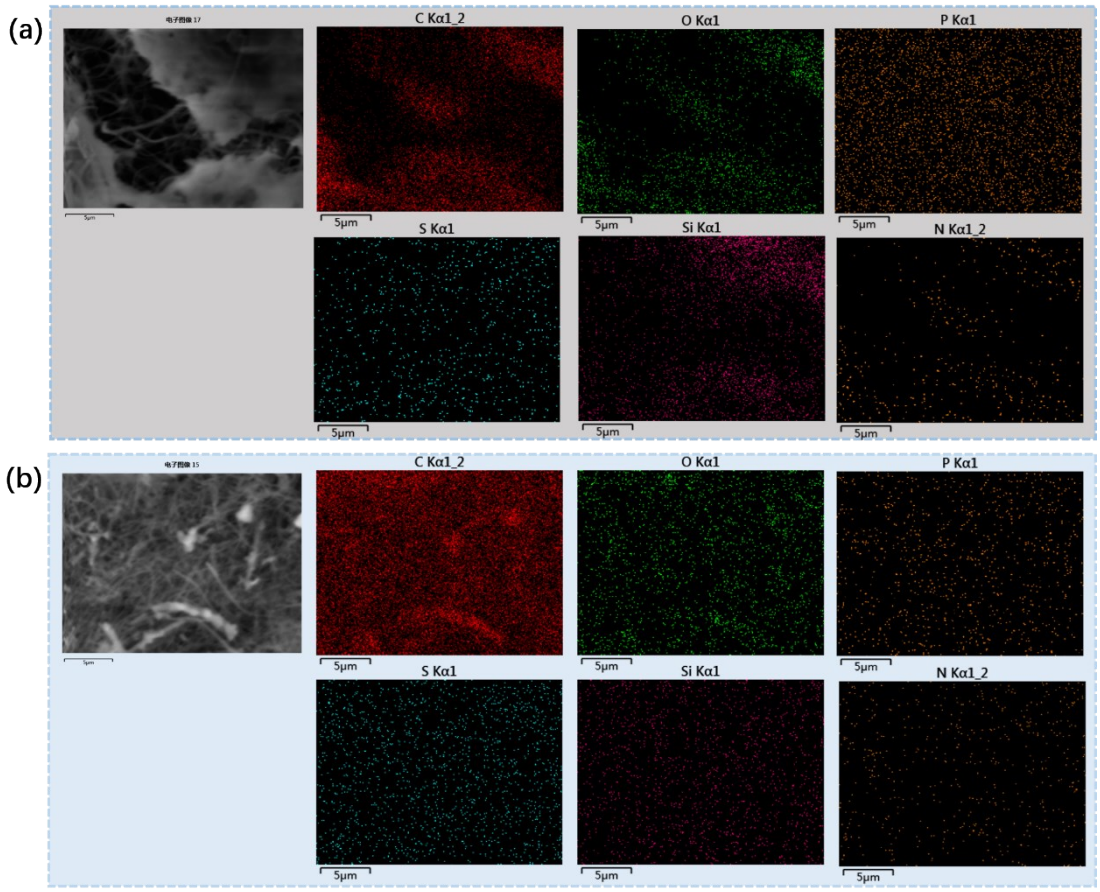

Figure S6. (a) EDS photographs of distribution of elements for C, O, P, S, Si and N on the surface of CMP-Bs after filtration. (b) EDS photographs of distribution of elements for C, O, P, S, Si and N on the surface of CMP-Bs after washing.

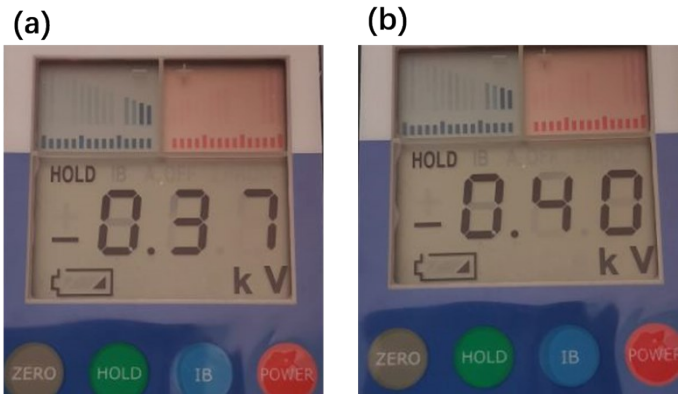

Figure S7. (a) The photograph of electrostatic force image for CMP-As. (b) The photograph of electrostatic force image for CMP-Bs.

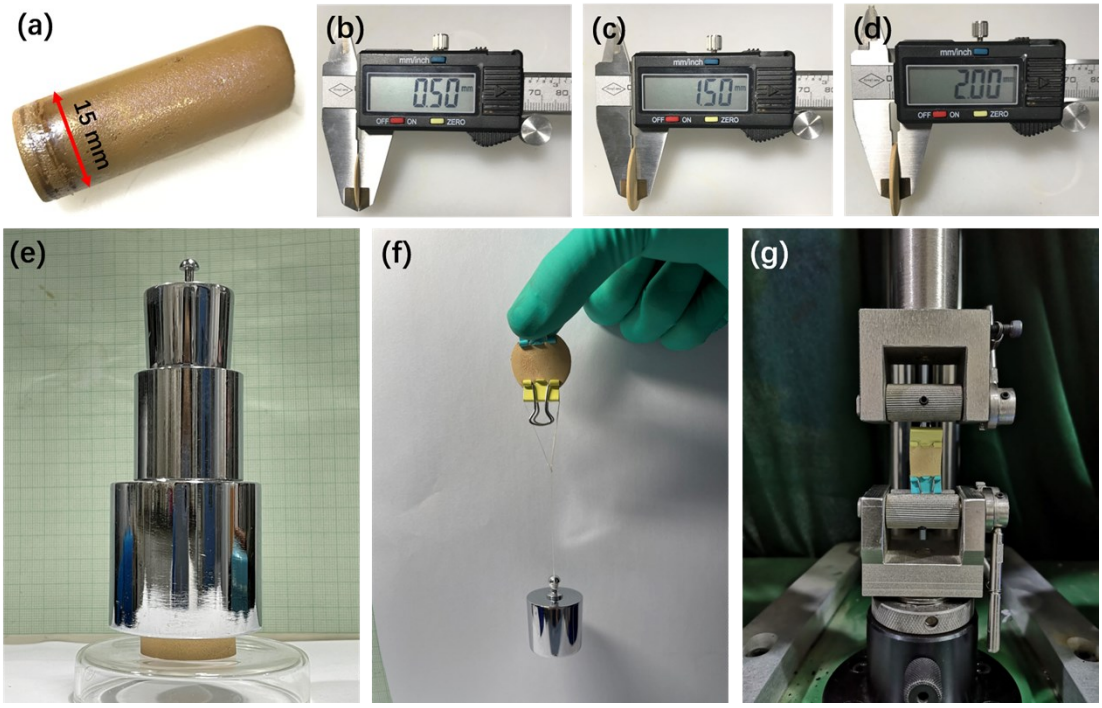

Figure S8. (a) Photograph of CMPs with a shape of column. (b~d) Photographs of CMPs filters with thickness of 0.5 mm, 1.5 mm and 2 mm. (e) Photograph of CMPs based blocks can withstand a weight of 800 g and still maintain the original appearance. (f) Photograph of CMPs based filter can trice a weight of 100 g easily. (g) Photograph of CMPs base filter in tensile test.

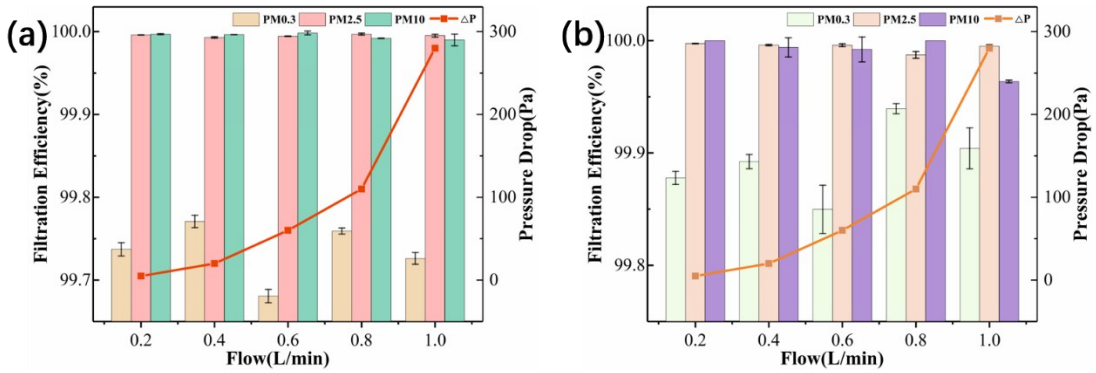

Figure S9. (a) The filtration efficiency and pressure drop of CMP-As with different flow. (b) The filtration efficiency and pressure drop of CMP-Bs with different flow.

Table S1. Quality factor of CMP-As and CMP-Bs in different flow rates.

folw (L/min)	QF of CMP-As			QF of CMP-Bs		
	$PM_{0.3}$	$PM_{2.5}$	PM_{10}	$PM_{0.3}$	$PM_{2.5}$	PM_{10}
0.2	1.19	2.03	2.08	1.34	2.10	1.91
0.4	0.30	0.48	0.51	0.34	0.51	0.49
0.6	0.10	0.16	0.18	0.11	0.17	0.16
0.8	0.05	0.09	0.09	0.07	0.08	0.08
1	0.02	0.04	0.03	0.02	0.04	0.03

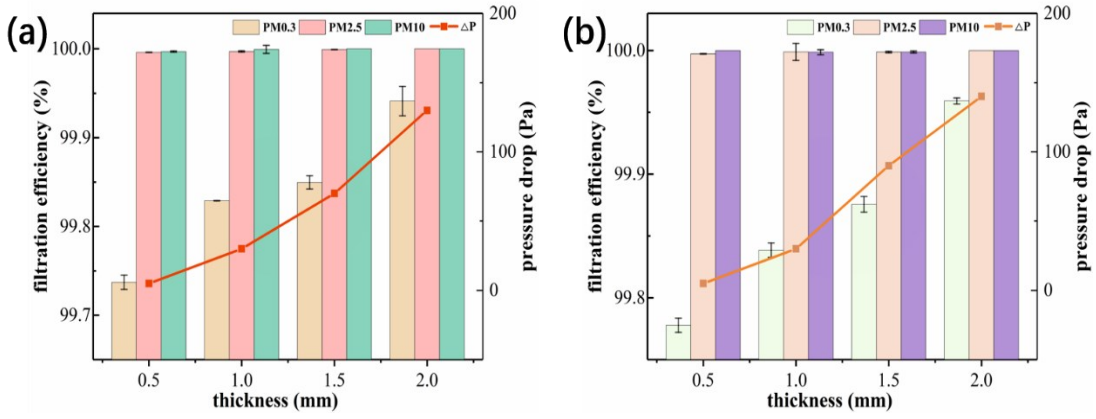

Figure S10. (a) The filtration efficiency and pressure drop of CMP-As with different thickness. (b) The filtration efficiency and pressure drop of CMP-Bs with different thickness.

Table S2. Quality factor of CMP-As and CMP-Bs with different thickness.

thickness (mm)	QF of CMP-As			QF of CMP-Bs		
	$PM_{0.3}$	$PM_{2.5}$	PM_{10}	$PM_{0.3}$	$PM_{2.5}$	PM_{10}
0.5	1.19	2.03	2.08	1.22	2.10	1.91
1.0	0.21	0.35	0.29	0.21	0.38	0.37
1.5	0.09	0.17	0.17	0.07	0.13	0.13
2	0.06	0.11	0.09	0.06	0.10	0.08