Polyethylene/polypropylene bicomponent spunbond air filtration materials containing magnesium stearate for efficient fine particle capture

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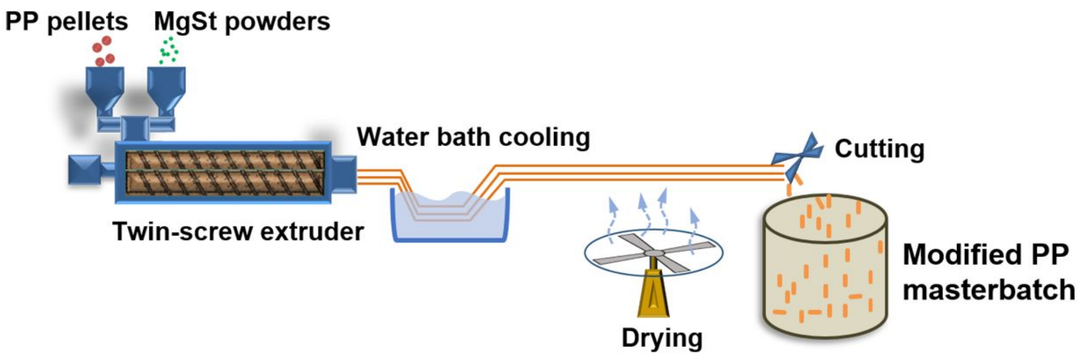

Figure S1. Schematic diagram of masterbatch pelleting process.

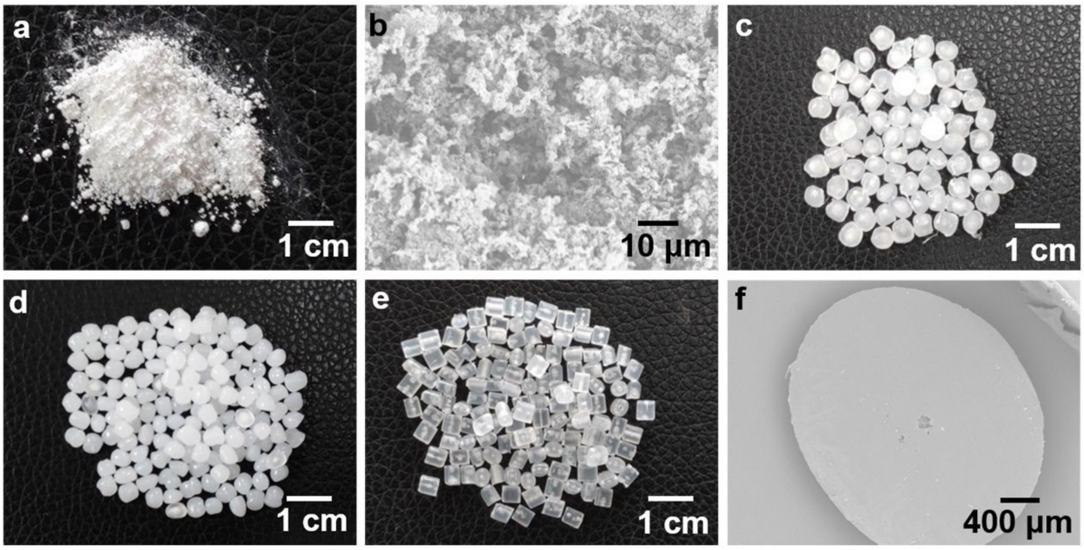

Figure S2. (a) Photograph of MgSt, (b) SEM image of MgSt, Photograph of (c) PP pellets, (d) PE pellets, (e) modified masterbatch pellets, (f) The cross-section SEM image of modified masterbatch pellets.

Table S1 The process parameters of spunbond technique.

Spinning temperature (℃)	Metering pump supply (cc min^{-1})	Throughput (g/hole/min)	Quenching air temperature (℃)	Drawing air pressure (kPa)	Through-air temperatur e (℃)	Forming belt speed (m min^{-1})
260	300	0.9	12	200	135	15

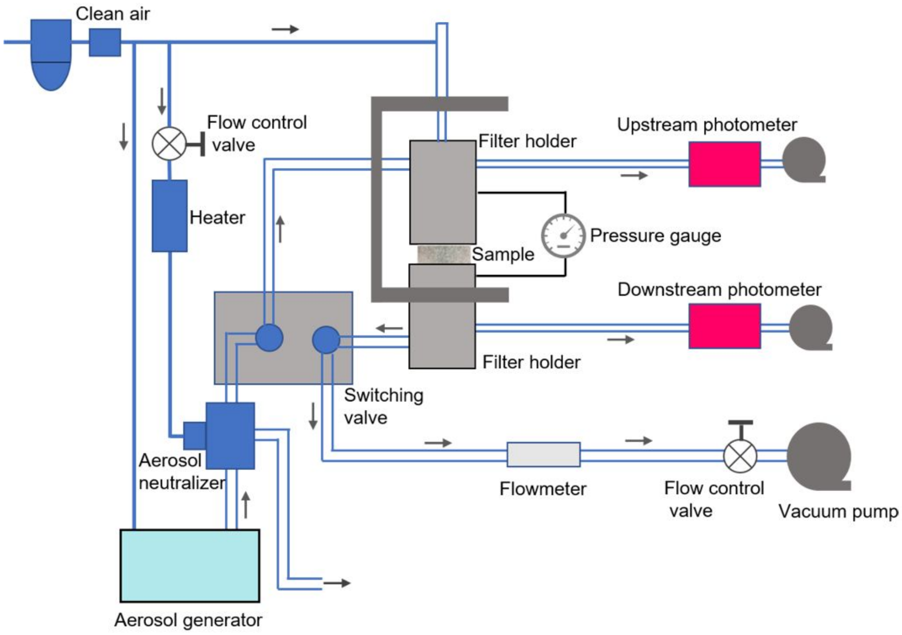

Figure S3. The schematic diagram of TSI 8130 automatic filter tester.

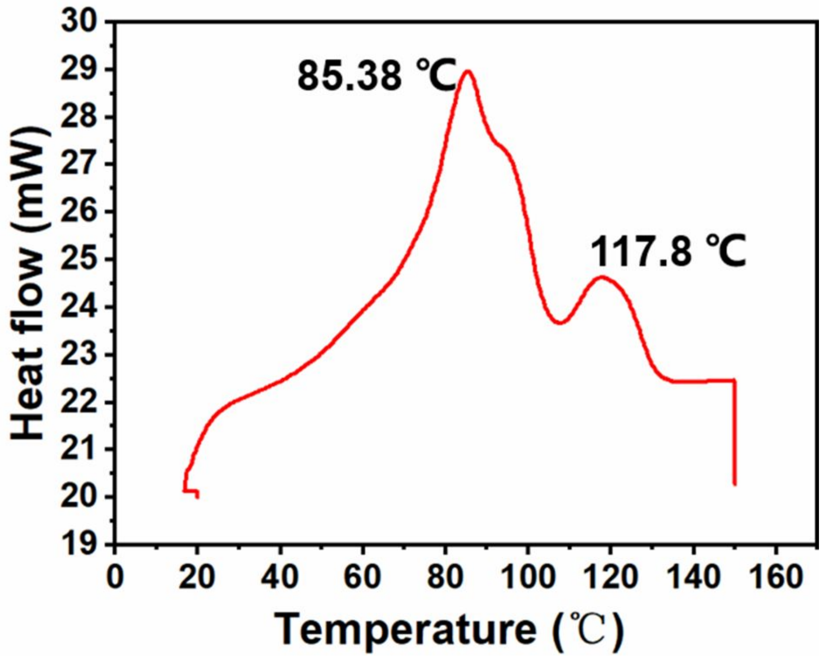

Figure S4. The DSC spectrum of MgSt.

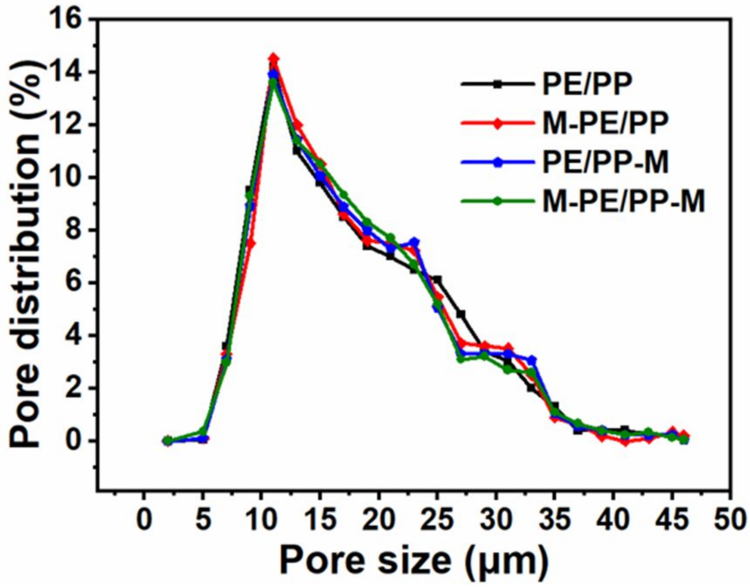

Figure S5. Pore size and pore size distribution of four as-prepared BCS samples of PE/PP, M-PE/PP, PE/PP-M, and M-PE/PP-M.

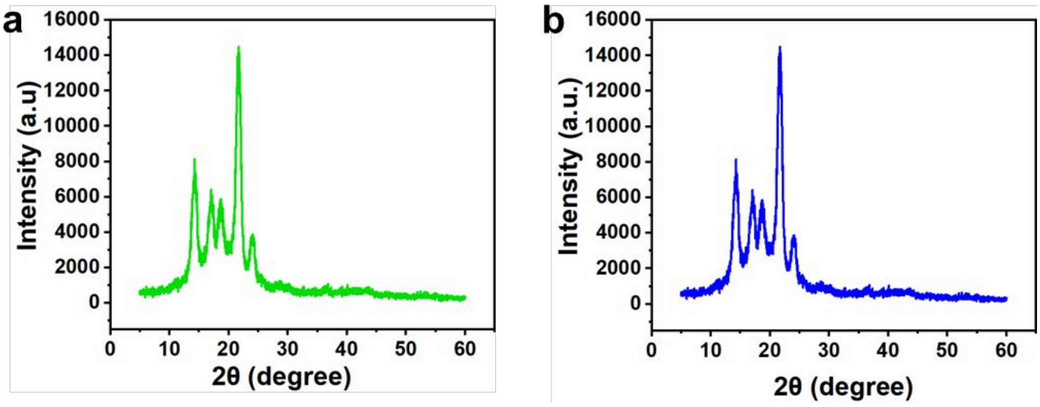

Figure S6. XRD patterns of (a) PE/PP and (b) M-PE/PP.

Table S2 Crystal parameters of PE/PP and M-PE/PP materials.

Samples	2θ (degrees)	Height	FWHM	Crystallite size (Å)
PE/PP	14.167	235	0.963	84
	17.056	126	0.920	88
	18.592	89	0.928	87
	21.640	510	0.859	95
	23.998	98	0.814	101
M-PE/PP	14.260	218	0.970	83
	17.126	112	0.945	85
	18.693	83	0.918	88
	21.716	457	0.883	92
	24.048	84	0.846	97

Note: The crystallize size is calculated by the Scherrer's formula:[1] $D = \frac{0.89\lambda}{\beta\cos\theta}$. Where λ is the X-ray wavelength (1.5418 Å), β is the full-width at half-maximum (FWHM) of the XRD peak in radians, and θ is the Bragg angle.

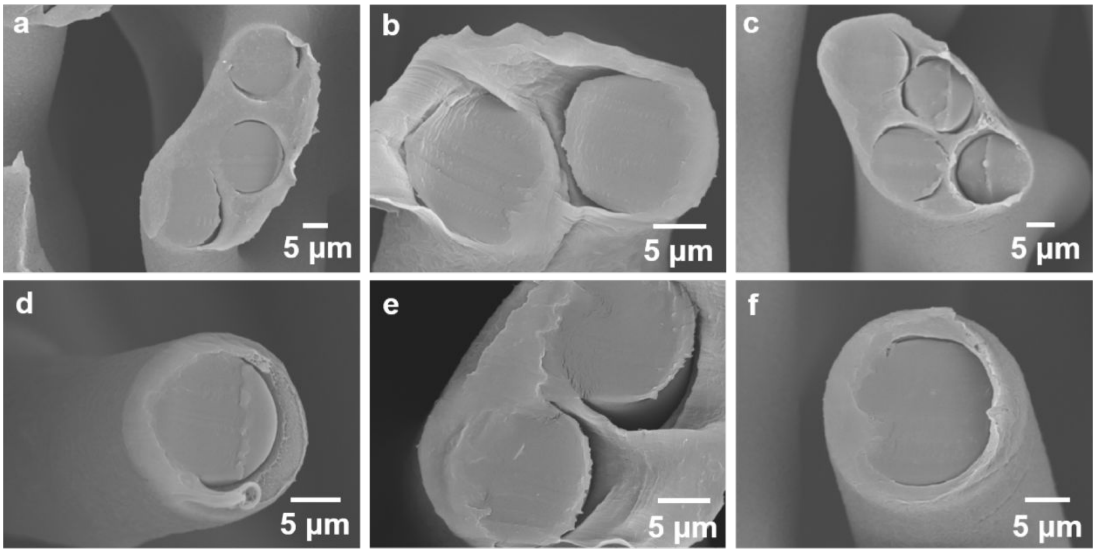

Figure S7. The cross-section SEM images of PE/PP BCS fibers containing various MgSt concentrations of (a) 0, (b) 0.2, (c) 0.4, (d) 0.6, (e) 0.8, and (f) 1 wt%, respectively.

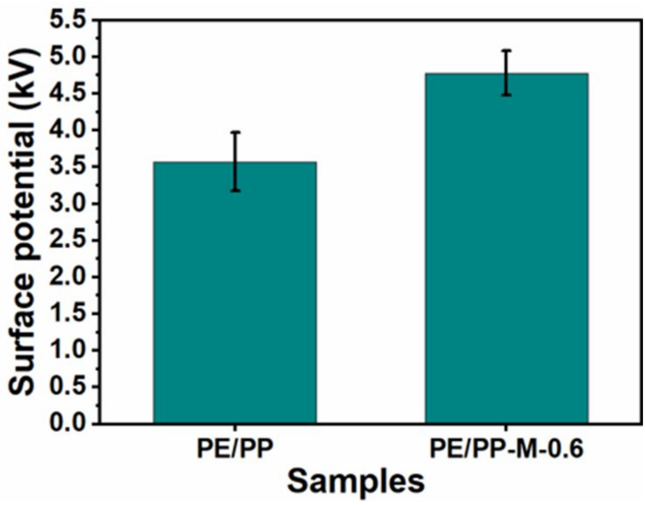

Figure S8. Surface potential of the PE/PP and PE/PP-M-0.6 samples.

Table S3 Crystal parameters of PE/PP and PE/PP-M-0.6 materials.

Samples	2θ (degrees)	Height	FWHM	XS (Å)
PE/PP	14.167	235	0.963	84
	17.056	126	0.920	88
	18.592	89	0.928	87
	21.640	510	0.859	95
	23.998	98	0.814	101
PE/PP-M-0.6	14.231	177	1.169	69
	16.996	57	0.970	83
	18.657	50	1.220	66
	21.665	546	0.867	94
	23.985	101	0.818	100

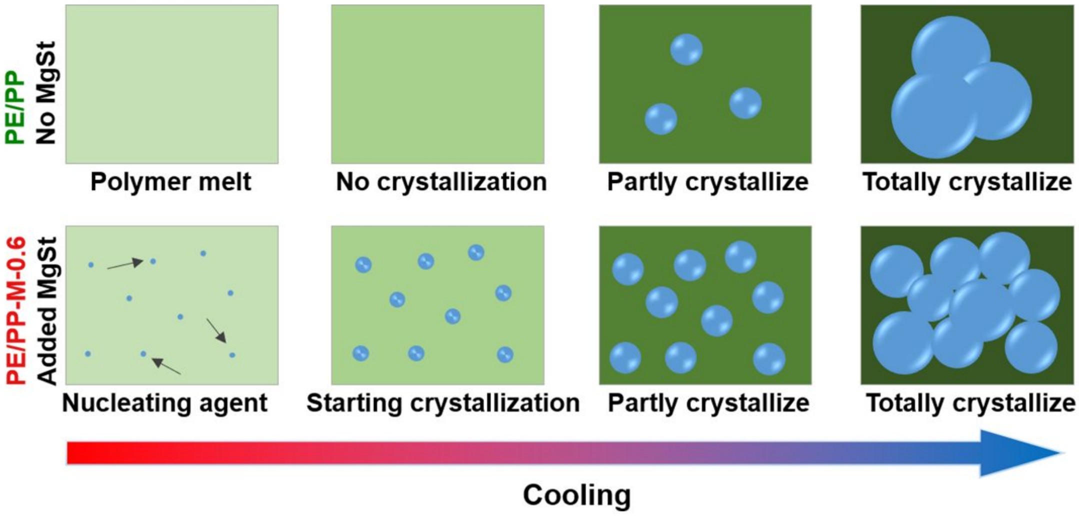

Figure S9. Nucleation processes of PE/PP and PE/PP-M-0.6 BCS samples.

Table S4 The filtration performance of materials in this work and other references.

Samples	Basic weight ($g\ m^{-2}$)	Filtration efficiency (%)	Pressure drop (Pa)	QF (Pa^{-1})
Spunbond PA6/PE[2]	127	64.1	26.4	0.038
Quartz fiber filter[3]	88.8	98.6	56.0	0.0764
Nanofiber Meltblown PP[4]	40	99.98	280	0.030
Electrospun PSU/PU[5]	6.79	99.94	184.6	0.040
PLA NMs[6]	5.21	99.997	165.3	0.063
HAP/CT paper[7]	30	93	240	0.11
Modified PP melt-blown[8]	90±5	99.22	270	0.018
PE/PP-M-0.6 (This work)	120	93.02	22.21	0.0964

*The filtration efficiency and pressure drop were tested under the face velocity of 5.3 cm s^{-1}. The QF was calculated by the following formula $QF = -\ln(1-\eta)/\Delta P$, where η and ΔP represented the filtration efficiency and pressure drop, respectively.

Table S5 Decrement of filtration efficiency (%).

Time (day)	PE/PP-M-0.6	PE/PP
1-30	3.1	6.75
30-60	0.81	1.23
60-90	0.2	0.51
0-90	4.1	8.73

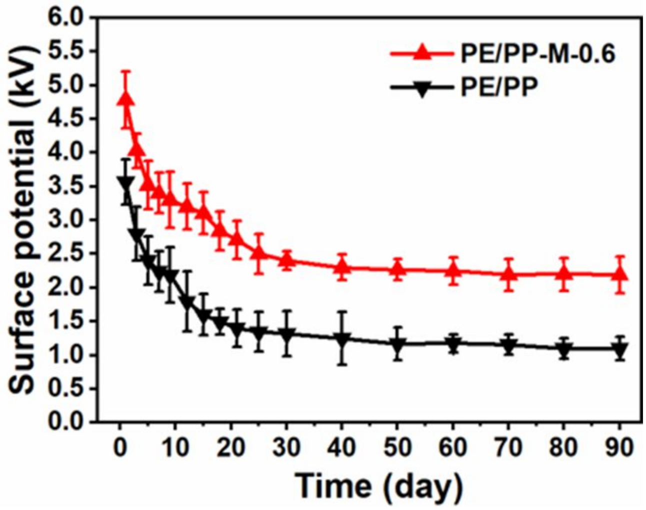

Figure S10. Surface potential decay of PE/PP-M-0.6 and PE/PP samples.

Table S6. Decrement of surface potential (%).

Time (day)	PE/PP-M-0.6	PE/PP
1-30	49.79	63.03
30-60	6.25	10.60
60-90	2.67	6.78
0-90	54.18	69.18

Tables S7 The basic information of electrospun and melt-blown samples.

Sample	Material	Basis weight ($g\ m^{-2}$)	Thickness (mm)	Fiber diameter (μm)	Filtration efficiency (%)	Pressure drop (Pa)
Electrospun	PAN	8.3	0.05	0.42	99.04	130.24
Melt-blown	PP	40	0.41	2.16	98.15	50.6

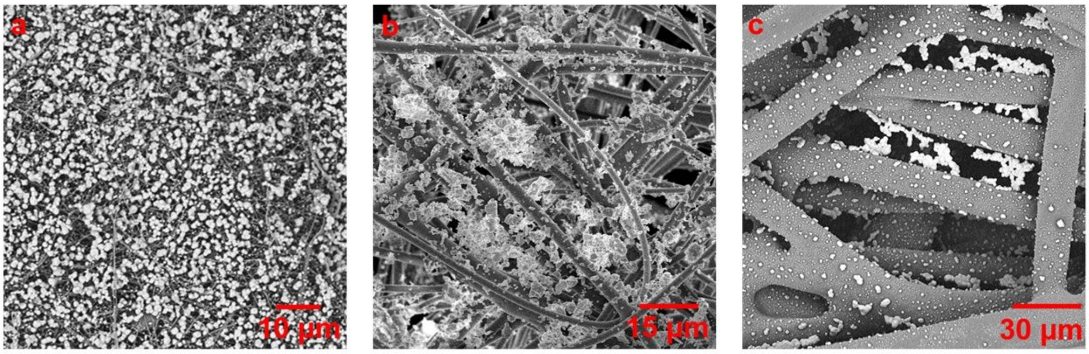

Figure S11. SEM images of after filtration (a) electrospun materials, (b) melt-blown materials, and (c) BCS materials.

Notes and references:

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