SUPPORTING INFORMATION

for

A one-step, scalable thermospray method for synthesis of multi-component particles mimicking atmospheric particulate matter

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Supporting tables

Table S1. Chemical compositions of $PM_{2.5}$ collected in Beijing region reported in the literature [1-15].

Ref. No.	Chemical composition (%)						
	Nitrate	Sulphate	Chloride	Ammonium	EC	OC	Metal
1	8.96	12.58	1.78	5.41	7.57	18.70	6.43
2	6.26	9.69	2.51	4.55	-	-	5.37
3	8.5	13.3	1.9	6.2	7	29	9.00
4	8.37	10.07	1.05	5.11	3.70	12.52	2.30
5	17.5	25.1	5.6	15.1	-	37.3	-
6	12-17	12-13	-	8-11	3-5	36-39	-
7	5.9-16.4	5.6-8.1	2.3-4.3	4.7-9.2	7.3-9.8	52.7-72.7	-
8	20	20	-	8		45	8.00
9	30.6	16.9	11	22.7	15	20	0.40
10	23	27	-	12	2	18	-
11	20	20	3.5	7	1.8	18.6-25.5	-
12	11.02	7.18	2.81	8.55	-	-	4.84
13	17.88	11.34	6.05	8.31	-	-	-
14	22-26	14-31	-	-	-		-
15	16	10.9	10.9	4.9	4.3	42.8	10.5

EC: element carbon; OC: organic carbon; metal: light elements (Na, Mg, Al, K, Ca) and heavy metals (Fe, Cu, Zn, Pb).

20 **Table S2.** Weighing records of multi-component compounds for spray-drying experiment.

Components	Reagent Information			Mass of each reagent in groups (g)		
	catalog	specifications	purity	Group 1	Group 2	Group 3
$NaNO_3$	10019918			0.0853	0.0839	0.0858
KNO_3	10017218			0.1032	0.1022	0.1001
NH_4Cl	10001518			0.0679	0.0681	0.0674
$(NH_4)_2SO_4$	10002918			0.2000	0.2016	0.2003
Ca $(NO_3)_2$	80029018	500 g		0.1001	0.1009	0.1026
$MgSO_4$	10013016			0.1417	0.1452	0.1422
Al $(NO_3)_3$	80003617		Analytical	0.0455	0.0465	0.0459
Pb $(NO_3)_2$	80073618		grade or	0.0097	0.0104	0.0113
$ZnSO_4$	10024028		above	0.0162	0.0147	0.0148
Black carbon	633100	1000 g		0.0662	0.0654	0.0669
SiO_2	637238	100 g		0.0048	0.0045	0.0049
Fe_3O_4	310069	100 g		0.0094	0.0079	0.0082
CuO	544868	50 g		0.0080	0.0076	0.0087
Lauric acid	8053331000	10 g		0.1153	0.1122	0.1125
Terephthalic acid	8007621000	100 g		0.1094	0.1104	0.1119

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Table S3. The detailed percentages of viable cells exposed to $PM_{2.5}$ concentrations (10, 20, 40, 50, 80, 100, 160, and 200 μg/mL).

Concentration (ng/mL)	Cell growth inhibition rate (%)	
	24 h	48 h
10	15.68	15.37
20	24.04	23.56
40	27.41	26.87
50	30.18	29.57
80	32.99	32.33
100	31.56	30.93
160	28.88	28.31
200	29.12	28.54

Table S4. The standard curve results of chloride, nitrate and sulfate.

Concentration (μg/mL)	Retention time(min)	Peak area	Peak height	Amount (μg/mL)
2.5	4.857	0.0744	0.587	2.821
5.0	4.857	0.1457	1.188	4.980
10.0	4.857	0.3094	2.538	9.937
20.0	4.860	0.6395	5.229	19.937
25.0	4.857	0.8057	6.554	24.973
50.0	4.857	1.6160	13.068	49.516
100.0	4.860	3.2910	26.486	100.253

Concentration (μg/mL)	Retention time(min)	Peak area	Peak height	Amount (μg/mL)
2.5	9.283	0.2265	0.927	2.622
5.0	9.283	0.4542	1.921	5.016
10.0	9.273	0.9334	3.987	10.051
20.0	9.260	1.8843	8.010	20.045
25.0	9.253	2.3603	9.961	25.048
50.0	9.223	4.6982	19.281	49.619
100.0	9.170	9.5079	36.721	100.167

Concentration (μg/mL)	Retention time(min)	Peak area	Peak height	Amount (μg/mL)
2.5	7.440	0.5962	2.311	2.197
5.0	7.440	1.2001	4.863	4.709
10.0	7.440	2.4676	10.520	9.980
20.0	7.437	4.9264	22.266	20.206
25.0	7.433	6.1314	28.364	25.217
50.0	7.433	12.0751	59.092	49.936
100.0	7.440	24.1000	118.656	99.944

Supporting figures

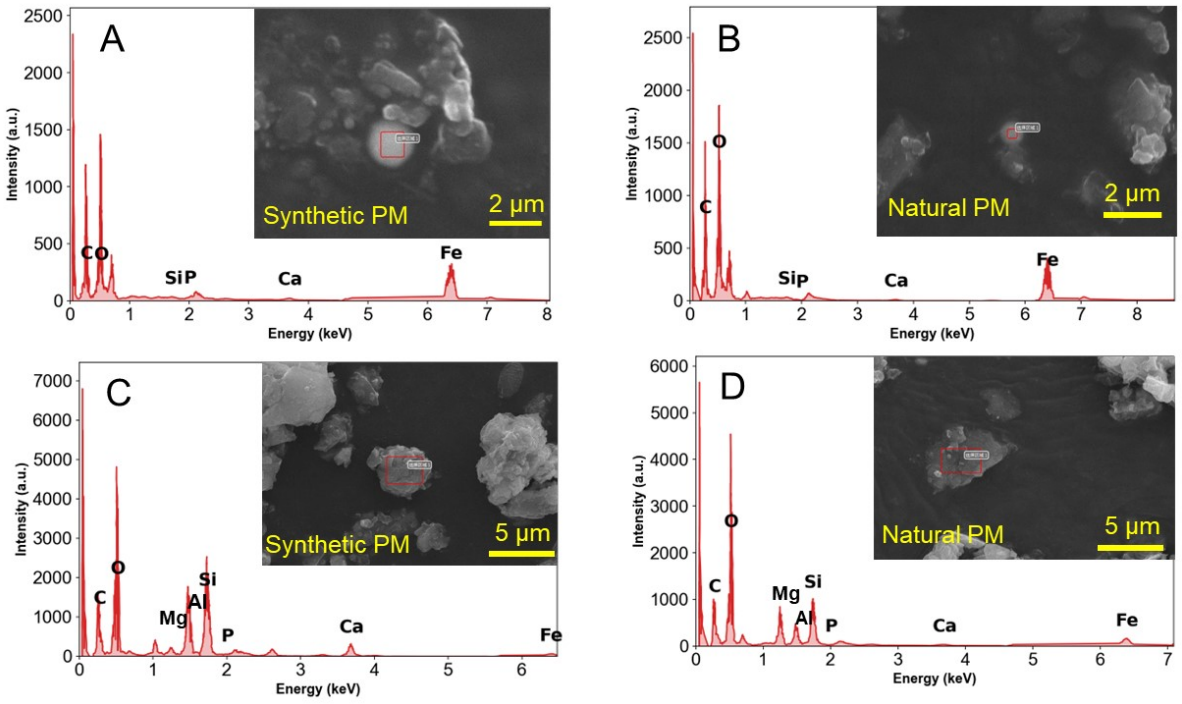
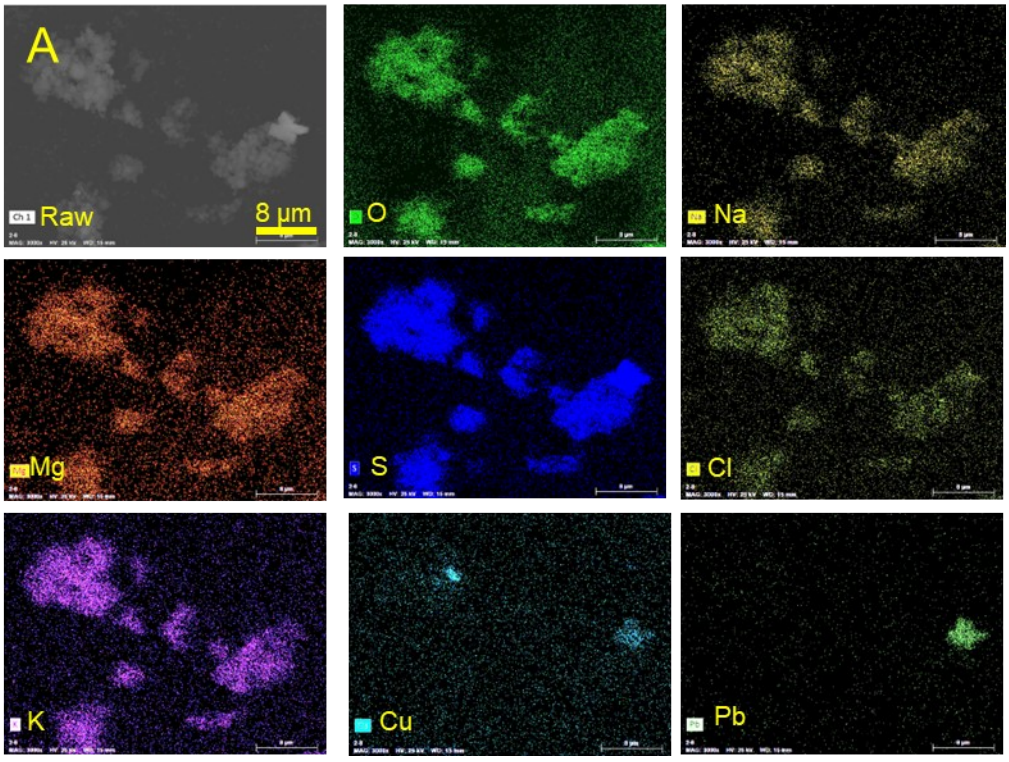


Figure S1. Particle morphology and elemental composition of iron oxides and silica oxides in synthetic $PM_{2.5}$ and real $PM_{2.5}$ samples characterized by SEM-EDX. (A) and (C) represent iron oxide particles and silica particles in the synthesized $PM_{2.5}$ samples, respectively. (B) and (D) represent iron oxide particles and silica particles in the real $PM_{2.5}$ samples, respectively.



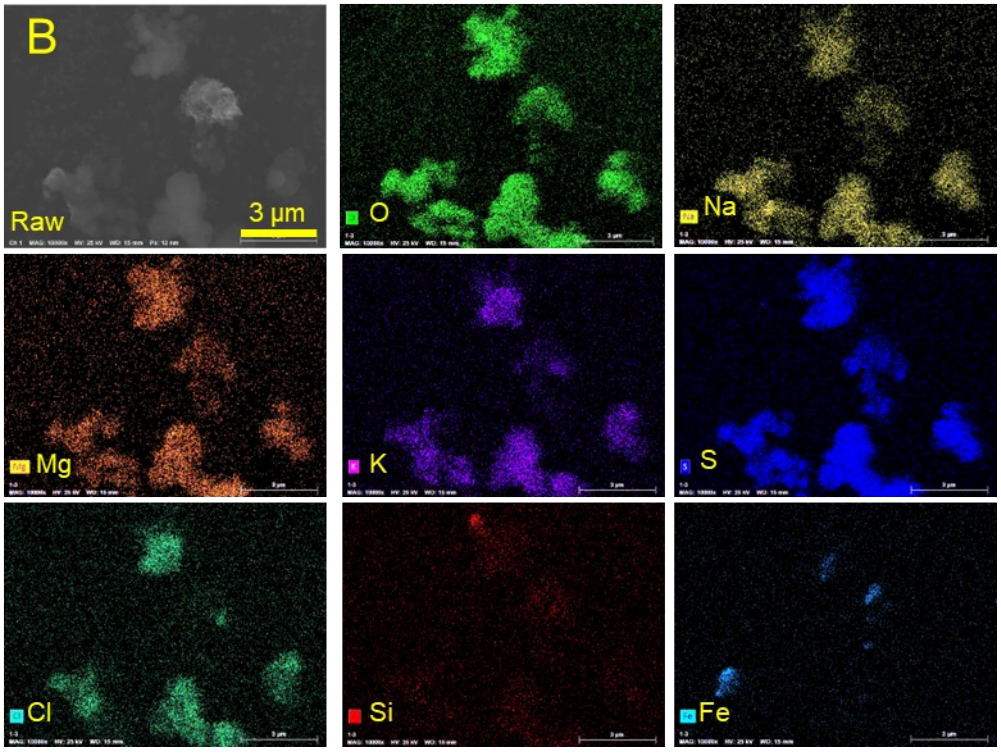


Figure S2. Homogeneous and heterogeneous elemental distributions of different elements in typical SEM images of two kinds of $PM_{2.5}$ samples. (A) Synthetic $PM_{2.5}$ samples. (B) Real $PM_{2.5}$ samples.

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