Supplementary Material

On the synergy between elemental carbon and inorganic ions in the determination of the electrical conductance properties of deposited aerosols: implications for energy applications

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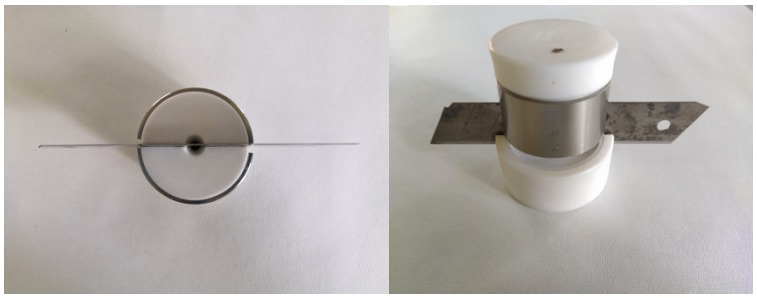

Figure S1: Guillotine cutter for filters.

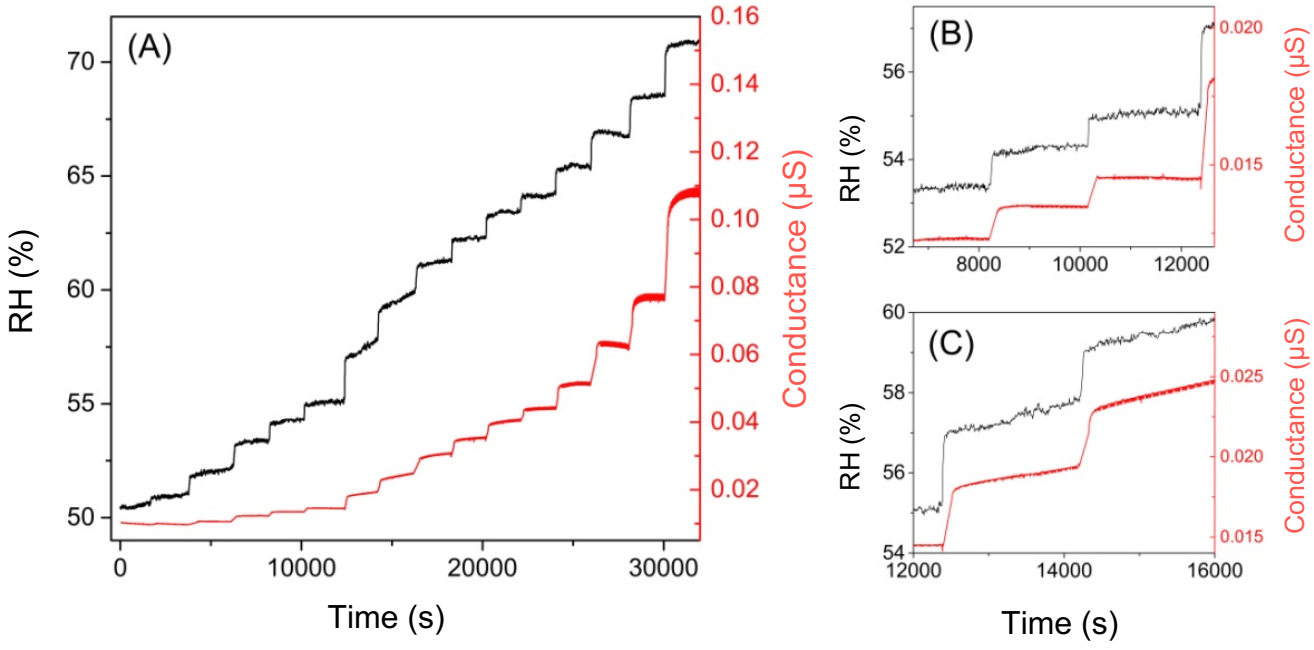

Figure S2: Conductance and RH equilibration (steps of 30 min) within the AEC on a $PM_{2.5}$ sample.

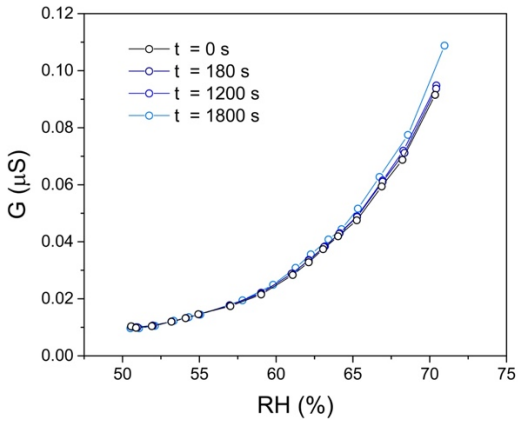

Figure S3: Conductance for each RH steps at 0 s, 180 s, 1200 s and 1800 s for the sample showed in Figure S1.

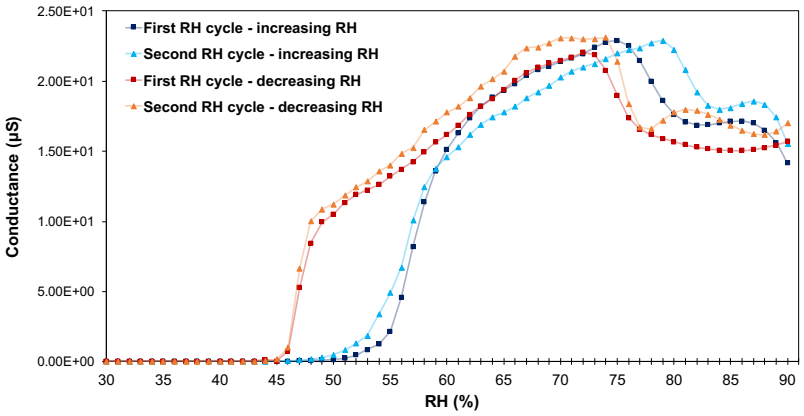

Figure S4: Conductance cycles repeated two times on the same $PM_{2.5}$ sample.

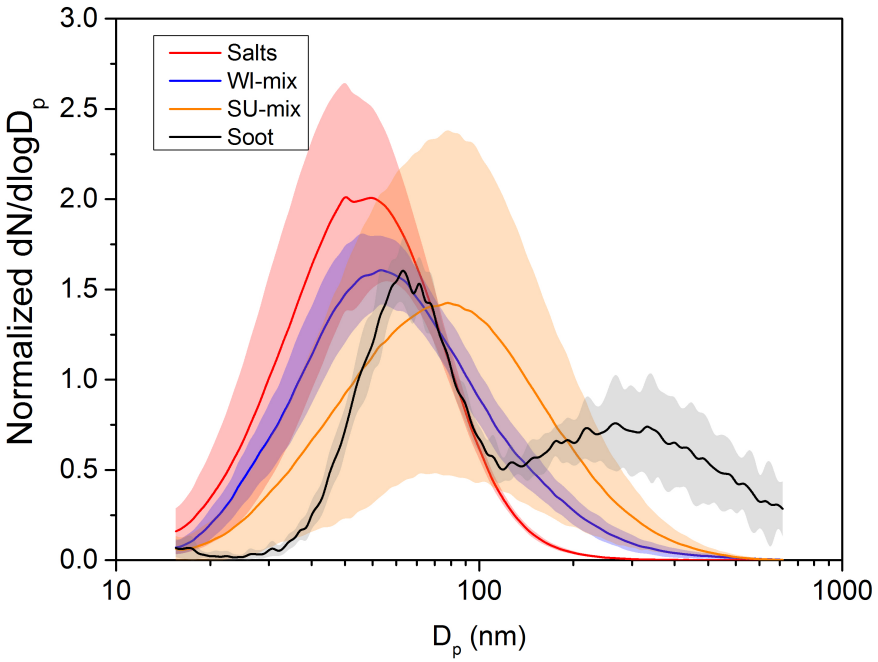

Figure S5: Normalized number size distribution of genetared salts, WI-mix, SU-mix and soot particles.

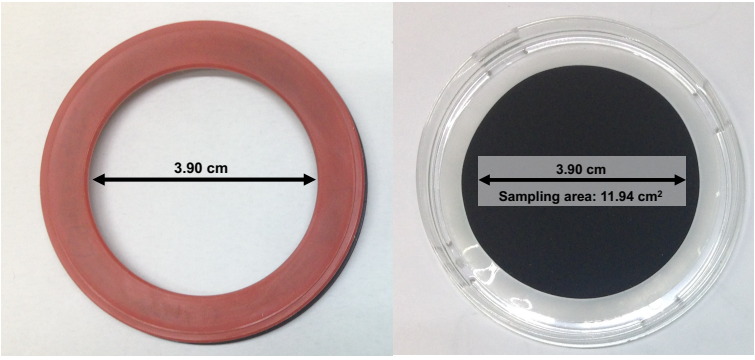

Figure S6: Active sampling spot size of a PTFE filter.

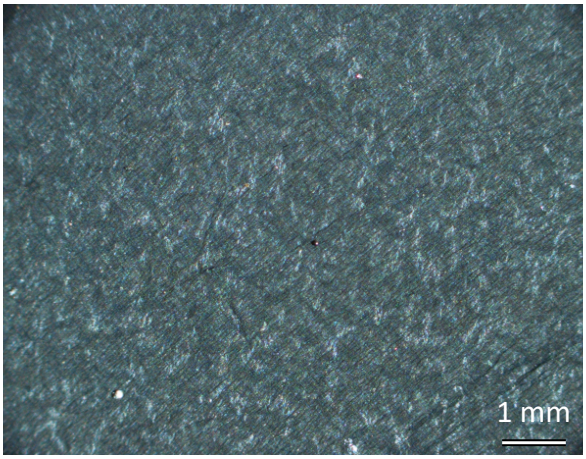

Figure S7: Stereomicroscope image (Leica Wild M420, 64x enlargement) for a $PM_{2.5}$ MI-TS ambient sample.

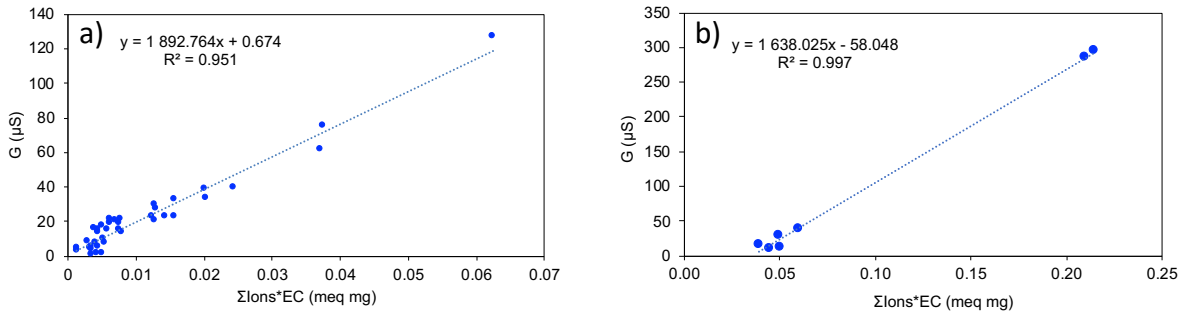

Figure S8: Correlation between tha conductance value at the DRH overcoming with the product (i.e. synergic effect) between the number of equivalent of inorganic ions and the mass of EC on filters both ambient (panel a) and laboratory generated (panel b). Note that the mass of EC cannot be transformed into moles as EC is not a well-defined molecule characterized by its own molecular weight.

Filter code	Site	Season	Sampling date	Loading (mg)	Spot (cm^2)	DET*	ED* (mm)	G* (µS)	F^- (µg)	Cl^- (µg)	NO_3^- (µg)	PO_4^{3-} (µg)	SO_4^{2-} (µg)	Na^+ (µg)	NH_4^+ (µg)	K^+ (µg)	Mg^{2+} (µg)	Ca^{2+} (µg)	∑Ions (µg)	EC (µg)	OC (µg)
B09-11	MI-TS	Winter	11/01/09	2.481	11.94	yes	5	0.57	0.97	19.07	279.74	n.d.	60.05	2.13	99.60	23.06	0.18	2.09	486.87	358.54	787.33
B384	MI-TS	Winter	22/12/06	2.845	11.94	yes	5	47.45	0.59	29.83	320.86	n.d.	110.97	5.54	141.91	24.60	0.71	7.07	642.08	396.09	869.77
B08-255	MI-TS	Summer	11/09/08	1.789	11.94	yes	5	19.47	1.25	2.59	90.28	n.d.	157.93	5.99	84.19	8.58	1.04	14.31	366.17	354.80	448.72
B381	MI-TS	Winter	19/12/06	1.224	11.94	yes	5	9.24	0.30	12.90	152.61	n.d.	63.19	4.05	73.49	13.85	0.52	5.21	326.12	161.44	354.51
B22	MI-TS	Winter	10/12/05	2.566	11.94	yes	5	20.80	0.97	34.22	226.15	n.d.	92.66	7.80	103.42	25.56	2.07	16.01	508.85	369.94	812.34
B382	MI-TS	Winter	20/12/06	2.555	11.94	yes	5	51.28	0.64	34.56	255.25	n.d.	102.61	4.98	127.80	17.33	1.19	6.49	550.85	360.41	791.42
B07-012	MI-TS	Winter	12/01/07	2.833	11.94	yes	5	52.63	n.d.	28.44	446.18	n.d.	195.70	4.99	196.28	20.14	1.22	6.99	899.95	347.50	763.08
B372	MI-TS	Winter	10/12/06	1.772	11.94	yes	5	4.53	n.d.	59.10	352.32	n.d.	65.43	2.89	152.71	13.57	0.43	2.28	648.73	201.90	443.36
B373	MI-TS	Winter	11/12/06	2.171	11.94	yes	5	22.49	n.d.	25.77	297.99	n.d.	70.80	4.40	121.05	14.73	0.63	4.35	539.73	293.30	644.06
B391	MI-TS	Winter	29/12/06	1.961	11.94	yes	5	0.97	n.d.	19.04	230.39	n.d.	259.17	4.68	171.86	14.73	0.25	2.78	702.90	226.21	496.73
B328	MI-TS	Autumn	14/10/06	2.861	11.94	yes	5	65.10	0.26	3.59	576.18	n.d.	315.61	5.77	286.94	11.91	1.01	6.68	1207.95	309.81	512.89
B329	MI-TS	Autumn	15/10/06	1.680	11.94	yes	5	1.59	0.20	3.59	75.10	n.d.	461.51	4.13	193.18	13.45	0.67	2.91	754.74	173.35	286.97
B07-87	MI-TS	Spring	28/03/07	2.795	11.94	yes	5	22.53	0.45	4.83	819.24	n.d.	478.38	5.08	378.12	18.24	2.60	20.07	1727.01	294.54	528.17
B08-100	MI-TS	Spring	09/04/08	2.170	11.94	yes	5	17.13	n.d.	18.12	497.38	n.d.	103.23	4.23	189.13	8.84	0.79	5.03	826.74	370.45	664.30
B193	MI-TS	Spring	28/05/06	2.296	11.94	yes	5	1.26	1.01	1.42	740.53	n.d.	266.23	2.66	304.59	2.70	0.64	3.42	1323.19	268.19	480.93
B08-254	MI-TS	Summer	03/07/09	1.248	11.94	yes	5	2.50	0.64	1.22	32.04	n.d.	123.82	4.48	50.47	4.99	0.83	6.09	224.60	255.19	322.75
OA08-315	OB	Autumn	10/11/08	1.869	11.94	yes	5	0.29	n.d.	12.86	709.25	n.d.	138.81	1.47	259.05	10.16	0.56	1.69	1133.84	58.80	246.55
OA08-330	OB	Autumn	25/11/08	2.167	11.94	yes	5	4.70	0.58	31.82	591.81	n.d.	141.58	2.84	233.56	19.30	0.30	1.87	1023.65	91.41	383.33
OA08-331	OB	Autumn	26/11/08	2.203	11.94	yes	5	18.24	0.61	34.90	450.40	n.d.	117.70	3.38	187.30	29.75	0.66	3.24	827.95	109.94	461.04
B44	MI-TS	Winter	31/12/05	3.764	11.94	yes	5	34.84	n.d.	1.38	130.59	n.d.	564.98	22.34	268.82	24.49	1.68	5.89	1020.17	493.28	1083.20
B07-004	MI-TS	Winter	04/01/07	2.906	11.94	yes	5	20.65	n.d.	0.66	78.04	n.d.	348.65	6.35	164.91	30.22	1.28	7.03	637.13	407.88	895.67
B322	MI-TS	Autumn	08/10/06	2.305	11.94	yes	5	16.73	n.d.	5.53	612.03	n.d.	155.96	3.03	229.71	5.22	0.82	2.24	1014.55	241.92	400.49
B08-092	MI-TS	Spring	01/04/08	1.818	11.94	yes	5	19.37	n.d.	3.16	276.05	n.d.	143.23	4.55	159.52	10.72	0.99	8.16	606.38	334.15	599.20
B333	MI-TS	Autumn	25/10/06	2.023	11.94	yes	5	38.03	n.d.	9.53	132.18	n.d.	169.62	9.15	99.23	8.96	1.38	5.70	435.74	297.55	492.58
B08-281	MI-TS	Autumn	07/10/08	2.407	11.94	yes	5	51.84	n.d.	9.49	423.90	n.d.	190.95	6.22	173.97	12.56	1.87	13.18	832.13	295.10	488.53
B08-283	MI-TS	Autumn	09/10/08	2.504	11.94	yes	5	49.15	n.d.	4.14	221.84	n.d.	168.58	4.25	130.82	9.06	1.10	14.56	554.36	365.34	604.81
B07-282	MI-TS	Autumn	09/10/07	2.119	11.94	yes	5	27.19	n.d.	3.29	599.64	n.d.	146.76	2.66	243.26	8.25	0.67	4.64	1009.17	208.07	344.45
B07-279	MI-TS	Autumn	06/10/07	1.674	11.94	yes	5	5.19	n.d.	7.04	360.36	n.d.	158.79	3.52	180.44	7.68	0.90	3.99	722.72	178.29	295.15
B390	MI-TS	Winter	28/12/06	2.474	11.94	yes	5	37.84	n.d.	21.13	237.30	n.d.	180.24	2.31	175.44	11.63	0.54	2.99	631.58	331.27	727.43
B340	MI-TS	Autumn	01/11/06	1.711	11.94	yes	5	18.71	n.d.	3.28	320.69	n.d.	196.94	4.79	177.24	10.15	1.04	4.85	718.97	185.99	307.90
B07-089	MI-TS	Spring	30/03/07	2.560	11.94	yes	5	40.28	n.d.	4.78	308.66	n.d.	171.53	4.03	176.54	7.37	1.09	17.79	691.79	515.23	923.91
B09-054	MI-TS	Winter	23/02/09	3.827	11.94	yes	6	95.10	n.d.	20.86	1214.08	n.d.	146.65	4.61	429.68	11.92	1.55	10.54	1839.89	357.28	784.56
B2	MI-TS	Autumn	17/11/05	3.834	11.94	yes	7	43.30	n.d.	38.09	827.61	n.d.	219.00	10.75	346.49	11.93	2.64	19.80	1476.30	441.88	731.51
B52	MI-TS	Winter	07/01/06	4.261	11.94	yes	8	62.10	n.d.	82.94	633.22	n.d.	163.01	30.44	277.64	14.89	1.10	6.93	1210.17	548.60	1204.67
B09-074	MI-TS	Winter	15/03/09	4.516	11.94	yes	9	74.76	n.d.	18.90	2156.74	n.d.	223.93	3.38	638.43	11.77	1.11	3.66	3057.92	262.10	575.55
B09-052	MI-TS	Winter	21/02/09	5.533	11.94	yes	10	149.01	1.54	50.03	1617.51	n.d.	182.44	11.76	474.49	15.46	4.29	46.83	2404.35	562.53	1235.27
B09-055	MI-TS	Winter	24/02/09	5.932	11.94	yes	11	127.77	n.d.	59.98	2430.78	n.d.	478.45	6.71	796.33	13.16	0.95	11.06	3797.43	383.85	842.91
B07-095	MI-TS	Spring	05/04/07	2.564	11.94	yes	5	49.10	n.d.	22.29	323.73	n.d.	254.12	4.25	224.37	7.87	1.31	13.42	851.35	472.42	847.15
B08-284	MI-TS	Autumn	10/10/08	2.940	11.94	yes	5	50.73	n.d.	6.54	671.30	n.d.	216.73	6.60	295.24	11.94	1.51	17.97	1227.84	320.95	531.33
B09-073	MI-TS	Winter	14/03/09	3.163	11.94	yes	5	22.56	n.d.	10.09	1101.33	n.d.	118.36	4.14	361.92	8.55	1.00	4.52	1609.91	279.31	613.33
B09-057	MI-TS	Winter	26/02/09	3.493	11.94	yes	5	56.26	0.71	36.18	741.44	n.d.	140.46	5.80	274.58	13.77	2.52	23.02	1238.48	405.30	890.01
B08-285	MI-TS	Autumn	11/10/08	3.773	11.94	yes	5	39.57	n.d.	13.99	1190.03	n.d.	247.65	8.03	422.54	11.19	1.42	9.99	1904.85	350.13	579.62
B07-91	MI-TS	Spring	01/04/07	1.434	11.94	no	5	n.d.	0.21	3.87	438.73	n.d.	161.18	2.06	192.20	3.75	0.34	2.70	805.06	173.36	310.87
B194	MI-TS	Spring	29/05/06	1.829	11.94	no	5	n.d.	0.92	3.13	474.22	n.d.	262.46	2.54	229.44	3.09	0.98	6.44	983.23	233.16	418.11
B287	MI-TS	Summer	03/09/06	0.893	11.94	no	5	n.d.	0.55	0.67	17.50	n.d.	207.69	4.65	84.16	2.74	0.67	2.59	321.21	142.66	180.43
B292	MI-TS	Summer	08/09/06	1.792	11.94	no	5	n.d.	0.67	1.72	183.30	n.d.	349.55	5.88	184.16	6.91	0.69	6.49	739.36	262.40	331.87
A09-176	MI-TS	Summer	10/09/08	0.981	11.94	no	5	n.d.	0.66	0.83	14.72	n.d.	142.26	2.16	57.77	2.48	0.59	5.55	227.02	188.01	237.78
OA08-333	OB	Autumn	28/11/08	1.395	11.94	no	5	n.d.	n.d.	21.09	294.88	n.d.	88.62	1.82	137.32	20.31	0.43	2.86	567.32	66.19	277.58
OA09-002	OB	Winter	02/01/09	1.670	11.94	no	5	n.d.	n.d.	6.42	358.20	n.d.	161.50	0.98	182.15	16.46	0.38	1.75	727.84	58.71	314.56
OA09-010	OB	Winter	10/01/09	1.245	11.94	no	5	n.d.	n.d.	10.59	275.62	n.d.	79.31	1.36	125.78	15.46	0.20	1.45	509.77	45.82	245.47
OB08-147	OB	Spring	26/05/08	1.915	11.94	no	5	n.d.	n.d.	6.49	597.49	n.d.	324.32	1.86	288.63	3.22	0.65	3.25	1225.92	62.60	262.51
OB08-150	OB	Spring	29/05/08	1.529	11.94	no	5	n.d.	n.d.	6.94	383.76	n.d.	298.23	4.01	221.25	9.51	1.16	5.69	930.56	54.38	228.05
OB08-178	OB	Summer	26/06/08	1.702	11.94	no	5	n.d.	n.d.	1.56	206.41	n.d.	290.46	1.65	175.77	3.81	1.65	7.94	689.26	99.84	343.80
OB08-179	OB	Summer	27/06/08	2.034	11.94	no	5	n.d.	n.d.	2.23	367.20	n.d.	440.72	2.45	280.83	5.80	1.86	7.36	1108.45	91.27	314.31
OA08-211	OB	Summer	29/07/08	1.195	11.94	no	5	n.d.	n.d.	1.40	80.38	n.d.	249.78	1.44	131.42	4.84	0.41	2.76	472.44	71.25	245.38
OA08-243	OB	Summer	30/08/08	1.334	11.94	no	5	n.d.	n.d.	1.78	104.42	n.d.	260.22	2.24	113.70	7.09	3.89	39.85	533.19	78.97	271.95
B316	MI-TS	Autumn	02/10/06	1.757	11.94	no	5	n.d.	n.d.	4.22	183.05	n.d.	369.29	3.37	189.05	9.72	1.08	3.70	763.49	186.14	308.15
B360	MI-TS	Autumn	28/11/06	1.498	11.94	no	5	n.d.	n.d.	14.90	252.91	n.d.	164.98	3.20	139.64	10.72	0.58	3.58	590.51	170.02	281.46
B09-127	MI-TS	Spring	07/05/09	1.554	11.94	no	5	n.d.	n.d.	2.92	335.45	n.d.	125.28	3.61	179.57	6.63	1.11	8.43	662.99	245.64	440.48
B08-280	MI-TS	Autumn	06/10/08	1.687	11.94	no	5	n.d.	n.d.	3.72	81.41	n.d.	98.94	6.65	42.31	11.41	1.48	11.59	257.51	267.98	443.63
B09-063	MI-TS	Winter	04/03/09	1.921	11.94	no	5	n.d.	n.d.	49.95	618.00	n.d.	141.50	2.16	256.27	8.21	0.19	1.74	1078.01	151.51	332.70
B08-101	MI-TS	Spring	10/04/08	1.303	11.94	no	5	n.d.	n.d.	8.86	316.67	n.d.	81.40	1.50	131.86	7.36	0.32	2.43	550.39	207.56	372.20

Table S1. Raw data of $PM_{2.5}$ ambient samples with sampling location (from Milano Torre Sarca, MI-TS, and Oasi Bine, OB), season, date, mass loading, surface spot size, electrical detection (DET*), electrode distance (ED*), conductance (maximum detected value, G*) and chemical data.

Filter code	Chemistry	Loading (mg)	Spot (cm^2)	DET*	ED* (mm)	G* (µS)	Cl^- (mg)	NO_3^- (mg)	SO_4^{2-} (mg)	Na^+ (mg)	NH_4^+ (mg)	∑Ions (mg)	EC (mg)
GS1	EC	0.061	11.94	yes	5	39.90	--	--	--	--	--	--	0.061
GS2	EC	0.036	11.94	yes	5	20.40	--	--	--	--	--	--	0.036
GS3	EC	0.037	11.94	yes	5	21.00	--	--	--	--	--	--	0.037
GS4	EC	0.024	11.94	yes	5	10.70	--	--	--	--	--	--	0.024
GS5	EC	0.098	11.94	yes	5	69.01	--	--	--	--	--	--	0.098
GS6	EC	0.172	11.94	yes	5	127.60	--	--	--	--	--	--	0.172
GS7	EC	0.239	11.94	yes	5	180.10	--	--	--	--	--	--	0.239
GS8	EC	0.090	11.94	yes	5	63.10	--	--	--	--	--	--	0.090
G1	EC+AS	3.801	11.94	yes	5	30.36	--	--	2.402	--	0.902	3.304	0.498
G2	EC+AN	3.768	11.94	yes	5	10.95		2.480	--	--	0.722	3.202	0.566
G3	EC+AC	5.982	11.94	yes	5	285.45	3.191	--	--	--	1.624	4.814	1.168
G4	EC+SC	6.918	11.94	yes	5	295.28	3.545	--	--	2.299	--	5.844	1.074
G5	EC+SS	4.681	11.94	yes	5	13.26	--	--	2.882	1.379	--	4.261	0.420
WI-mix	EC+(24%AS+76%AN)	4.081	11.94	yes	5	16.90	--	2.480	0.336	--	0.848	3.664	0.417
SU-mix	EC+(86%AS+14%AN)	4.392	11.94	yes	5	38.43	--	0.186	2.642	--	1.046	3.874	0.518

Table S2. Raw data of laboratory generated PM samples with generation chemistry, mass loading, surface spot size, electrical detection (DET*), electrode distance (ED*), conductance (maximum detected value, G*).