Supplement of Atmos. Chem. Phys., 24, 1345–1360, 2024
https://doi.org/10.5194/acp-24-1345-2024-supplement

Atmospheric Chemistry and Physics
Open Access

Supplement of

Source differences in the components and cytotoxicity of $PM_{2.5}$ from automobile exhaust, coal combustion, and biomass burning contributing to urban aerosol toxicity

Xiao-San Luo et al.

Correspondence to: Xiao-San Luo (xsluo@nuist.edu.cn)

Captions of figures and tables

Figure S1. Schematic of a dilution 4-channel sampler used for collecting $PM_{2.5}$ directly from various combustion source emissions.

Figure S2. Samples of $PM_{2.5}$ loaded in quartz filters collected from 30 typical anthropogenic combustion sources (a: automobile exhaust; b: coal combustion; c: domestic plant biomass burning).

Figure S3. Example of daily urban air $PM_{2.5}$ concentrations (μg m^{-3}) monitored in Nanjing city, eastern China.

Figure S4. The PMF factor profiles of various components and source percentages of secondary aerosol, automobile exhaust, coal combustion, and plant biomass burning contributing to the urban ambient air $PM_{2.5}$.

Figure S5. Contents (mg kg^{-1}) and ratio of carbon fractions in $PM_{2.5}$ from 10 types of automobile exhaust.

Figure S6. Contents (mg kg^{-1}) and ratio of carbon fractions in $PM_{2.5}$ from 10 types of coal combustion.

Figure S7. Contents (mg kg^{-1}) and ratio of carbon fractions in $PM_{2.5}$ from 10 types of domestic plant biomass burning.

Figure S8. Contents (mg kg^{-1}) and ratio of carbon fractions in ambient air $PM_{2.5}$ from Nanjing city, eastern China.

Figure S9. Heavy metal contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of automobile exhaust.

Figure S10. Heavy metal contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of coal combustion.

Figure S11. Heavy metal contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of domestic plant biomass burning.

Figure S12. Heavy metal contents (mg kg^{-1}) in ambient air $PM_{2.5}$ from Nanjing city, eastern China.

Figure S13. Water-soluble ions (WSIs) contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of automobile exhaust.

Figure S14. Water-soluble ions (WSIs) contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of coal combustion.

Figure S15. Water-soluble ions (WSIs) contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of domestic plant biomass burning.

Figure S16. Water-soluble ions (WSIs) contents (mg kg^{-1}) in monthly ambient air $PM_{2.5}$ from Nanjing city, eastern China.

Figure S17. Cell viability, oxidative stress and inflammation levels exposed to $PM_{2.5}$ from 10 types of automobile exhaust.

Figure S18. Cell viability, oxidative stress and inflammation levels exposed to $PM_{2.5}$ from 10 types of coal combustion.

Figure S19. Cell viability, oxidative stress and inflammation levels exposed to $PM_{2.5}$ from 10 types of domestic plant biomass burning.

Figure S20. Cell viability, oxidative stress and inflammation levels exposed to various ambient air $PM_{2.5}$ from Nanjing city, eastern China.

Table S1. Characteristics and collection process of the investigated typical vehicles.

Table S2. Characteristic analysis and collection process of typical coal samples.

Table S3. Characteristic analysis and collection process of typical domestic plant biomass fuel samples.

Table S4. The CMB source profiles of coal combustion, plant biomass burning, automobile exhaust, and secondary sources (g/g).

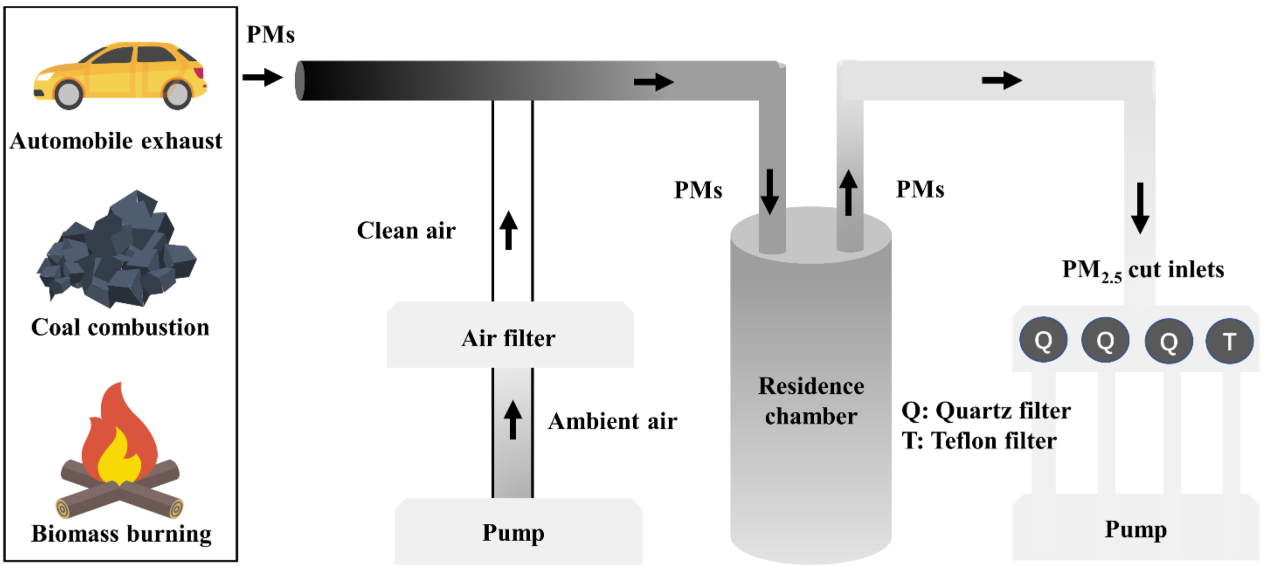


Figure S1. Schematic of a dilution 4-channel sampler used for collecting $PM_{2.5}$ directly from various combustion source emissions.

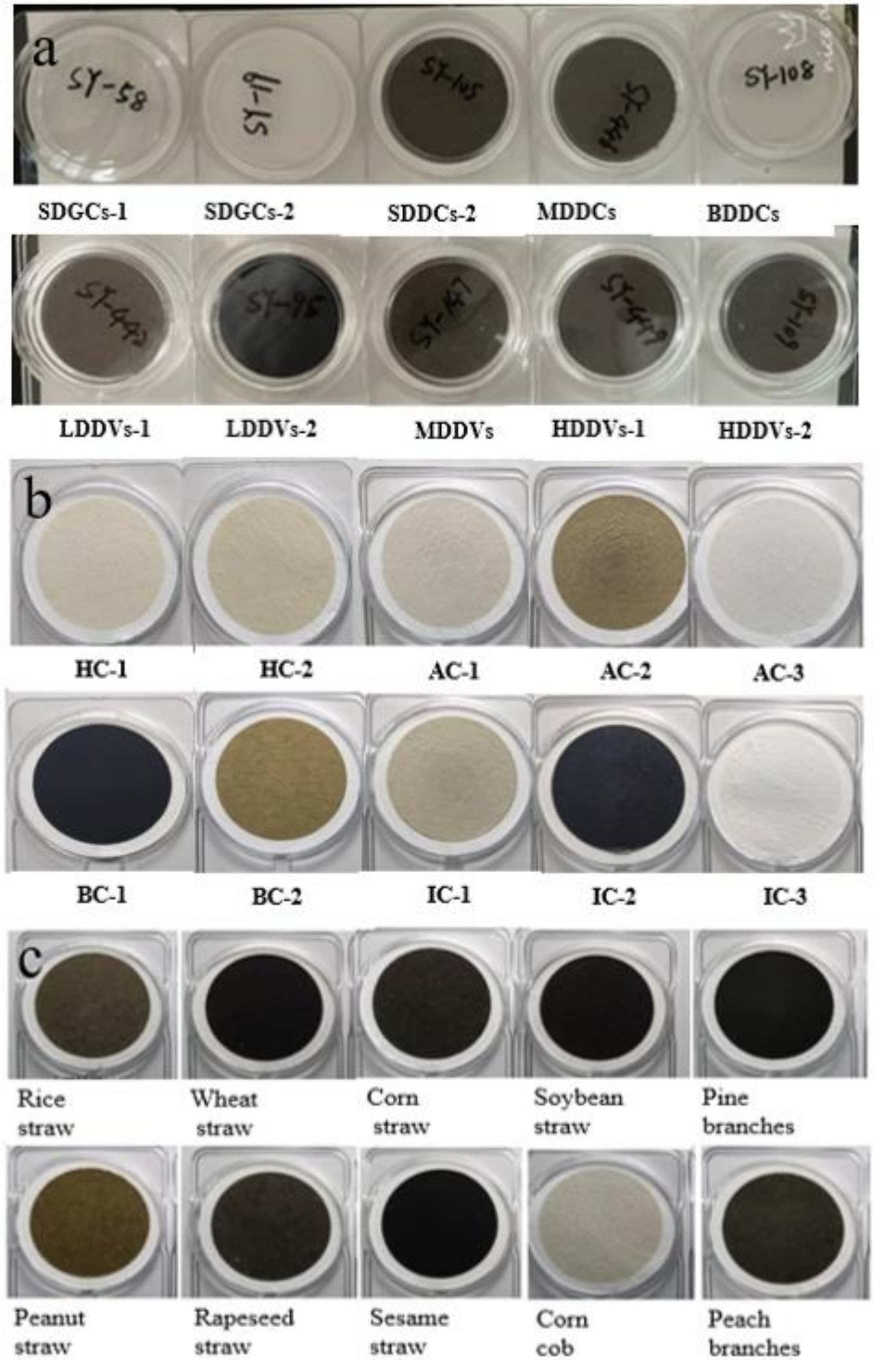


Figure S2. Samples of $PM_{2.5}$ loaded in quartz filters collected from 30 typical anthropogenic combustion sources (a: automobile exhaust; b: coal combustion; c: domestic plant biomass burning).

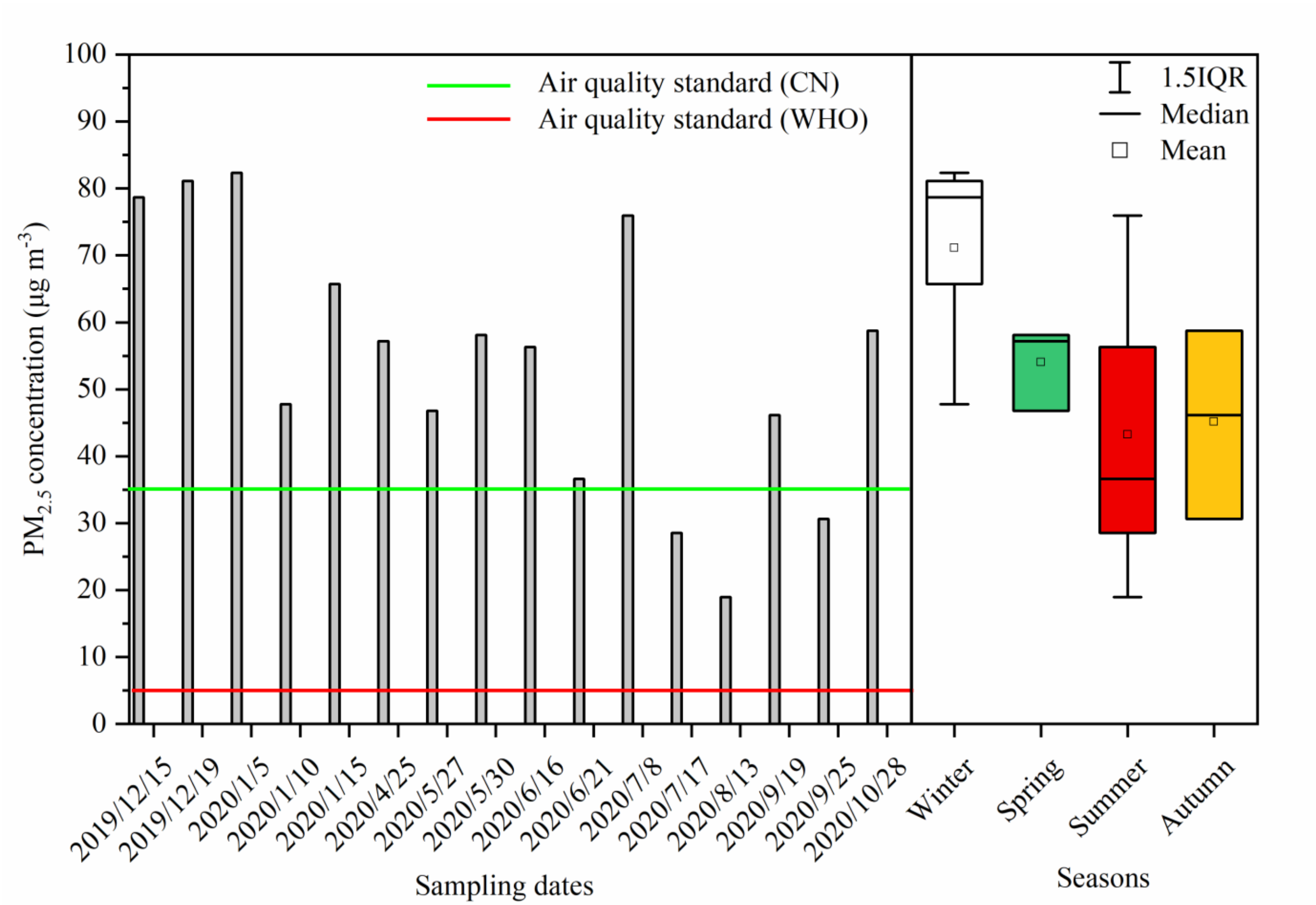


Figure S3. Example of daily urban air $PM_{2.5}$ concentrations (μg m^{-3}) monitored in Nanjing city, eastern China.

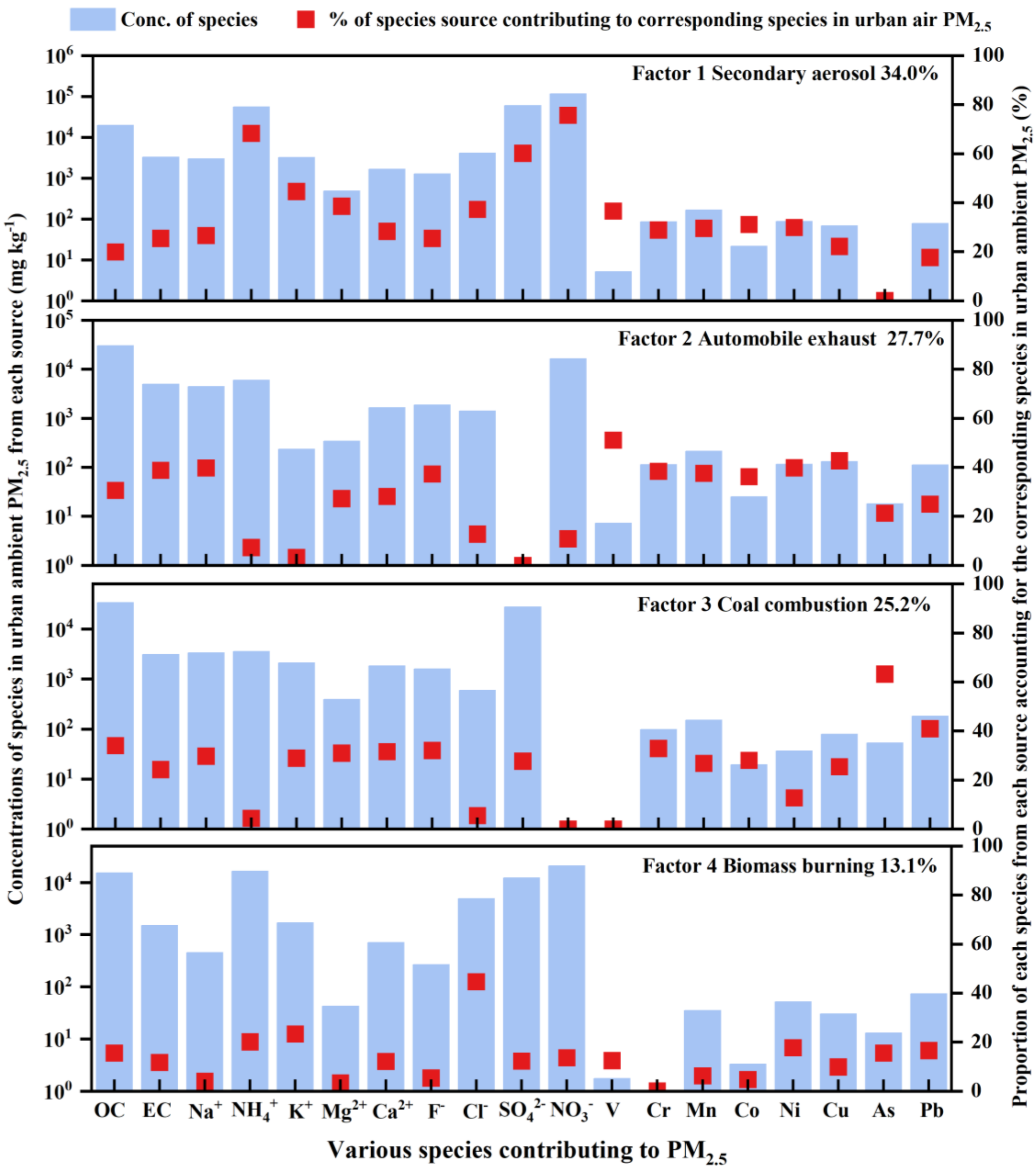


Figure S4. The PMF factor profiles of various components and source percentages of secondary aerosol, automobile exhaust, coal combustion, and plant biomass burning contributing to the urban ambient air $PM_{2.5}$.

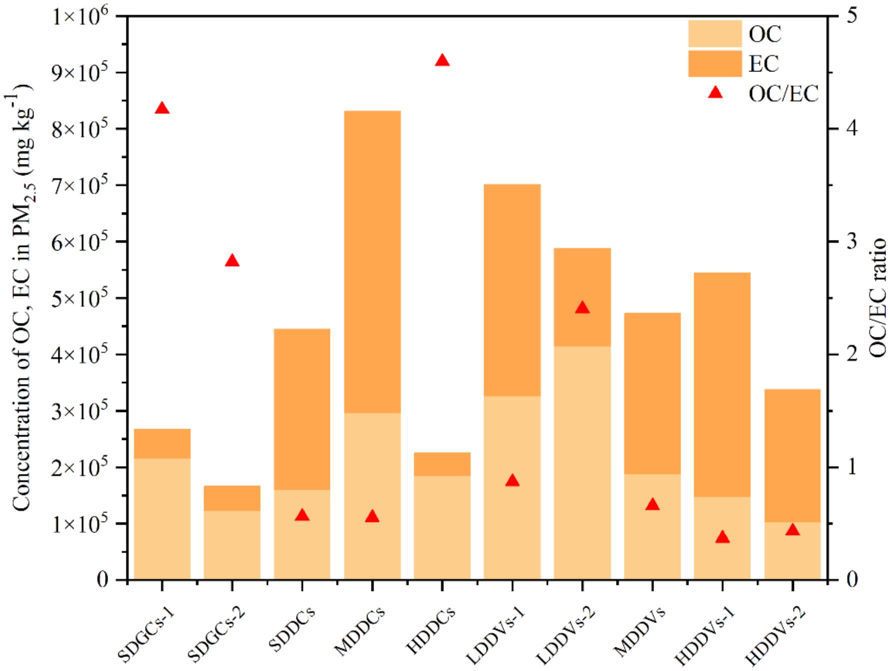


Figure S5. Contents (mg kg^{-1}) and ratio of carbon fractions in $PM_{2.5}$ from 10 types of automobile exhaust.

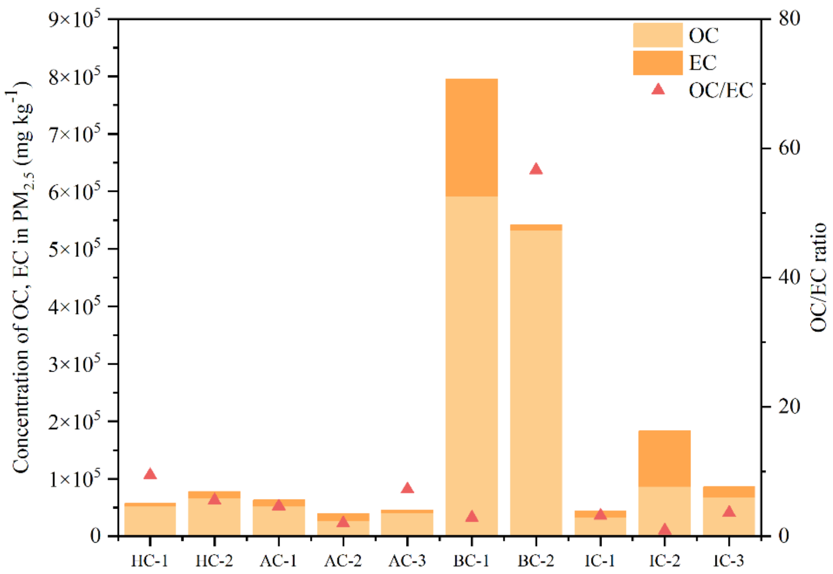


Figure S6. Contents (mg kg^{-1}) and ratio of carbon fractions in $PM_{2.5}$ from 10 types of coal combustion.

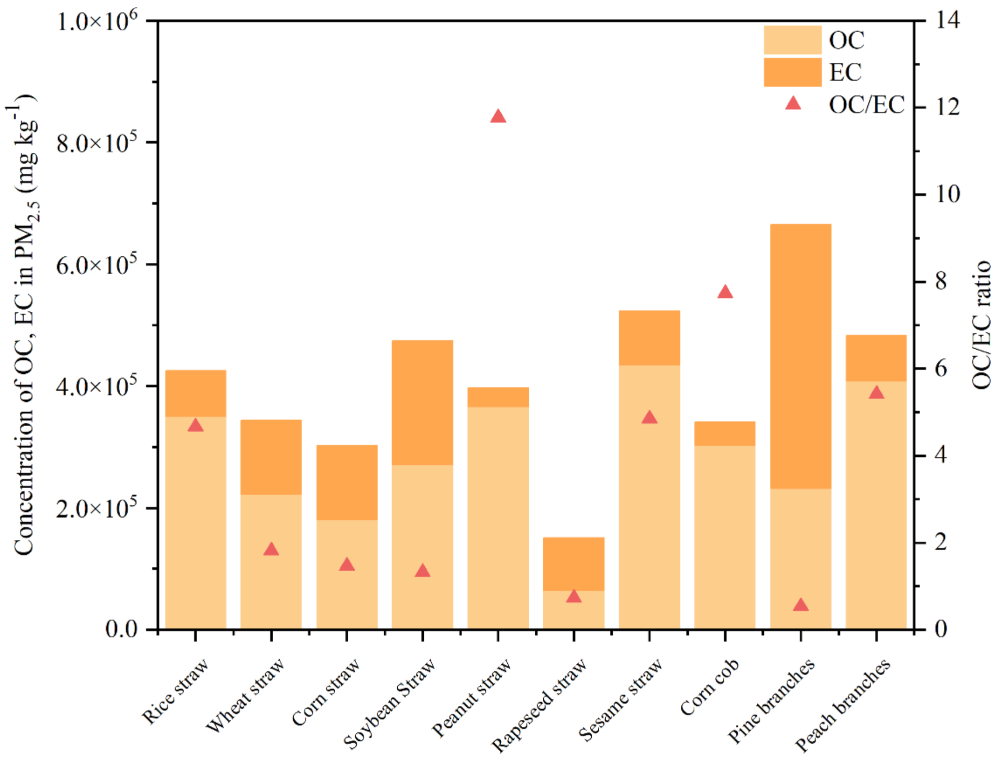


Figure S7. Contents (mg kg^{-1}) and ratio of carbon fractions in $PM_{2.5}$ from 10 types of domestic plant biomass burning.

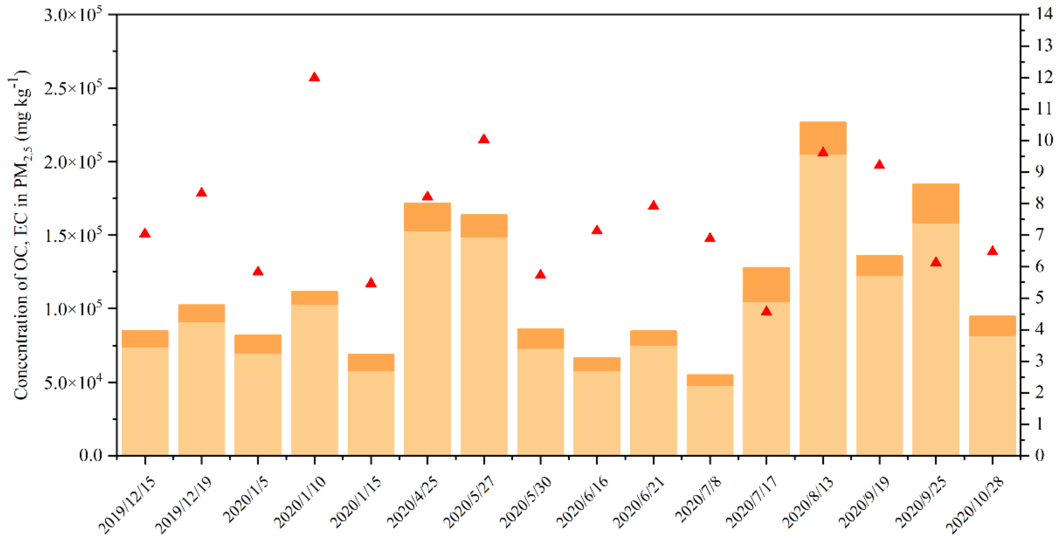


Figure S8. Contents (mg kg^{-1}) and ratio of carbon fractions in ambient air $PM_{2.5}$ from Nanjing city, eastern China.

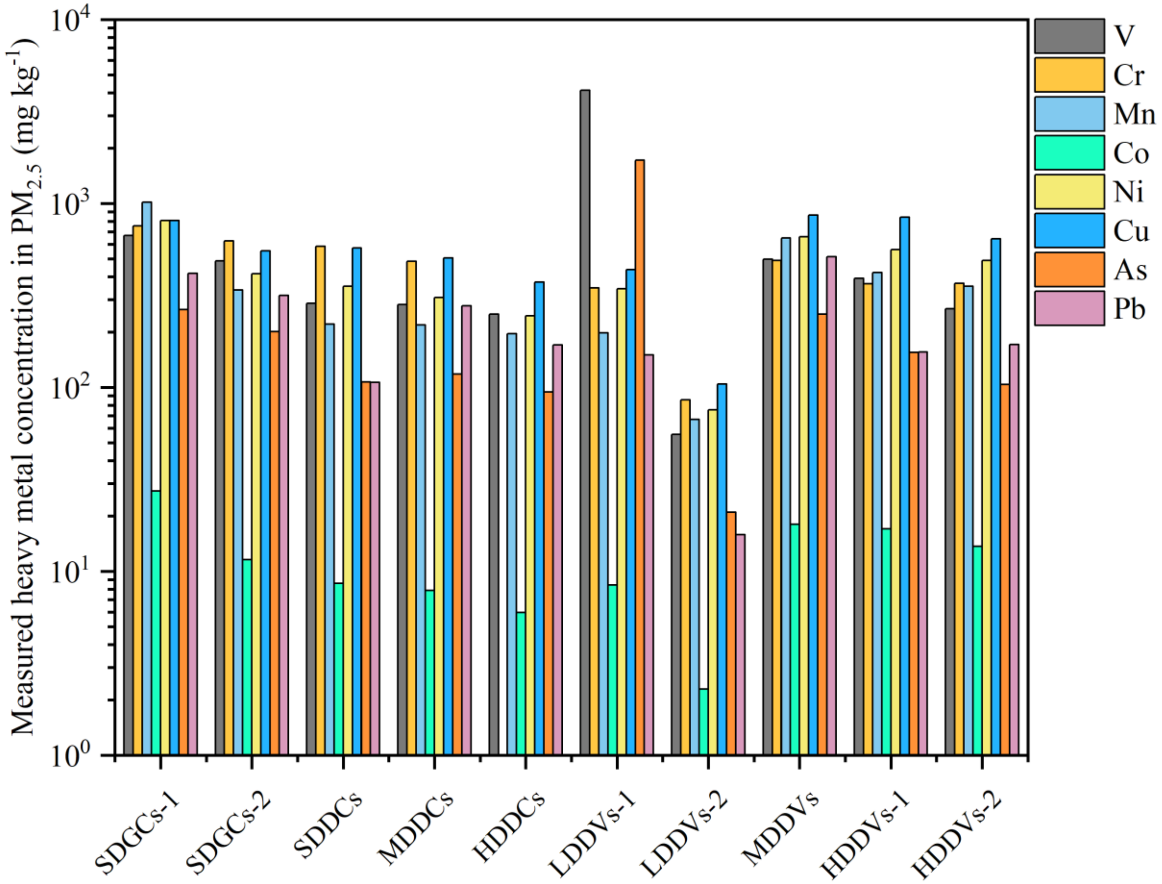
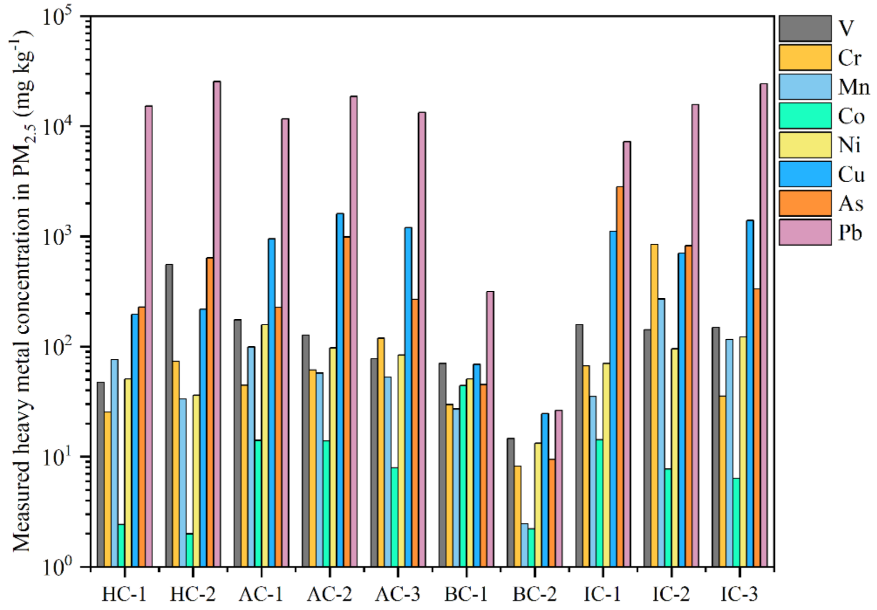


Figure S9. Heavy metal contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of automobile exhaust.



78
79 **Figure S10. Heavy metal contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of coal combustion.**

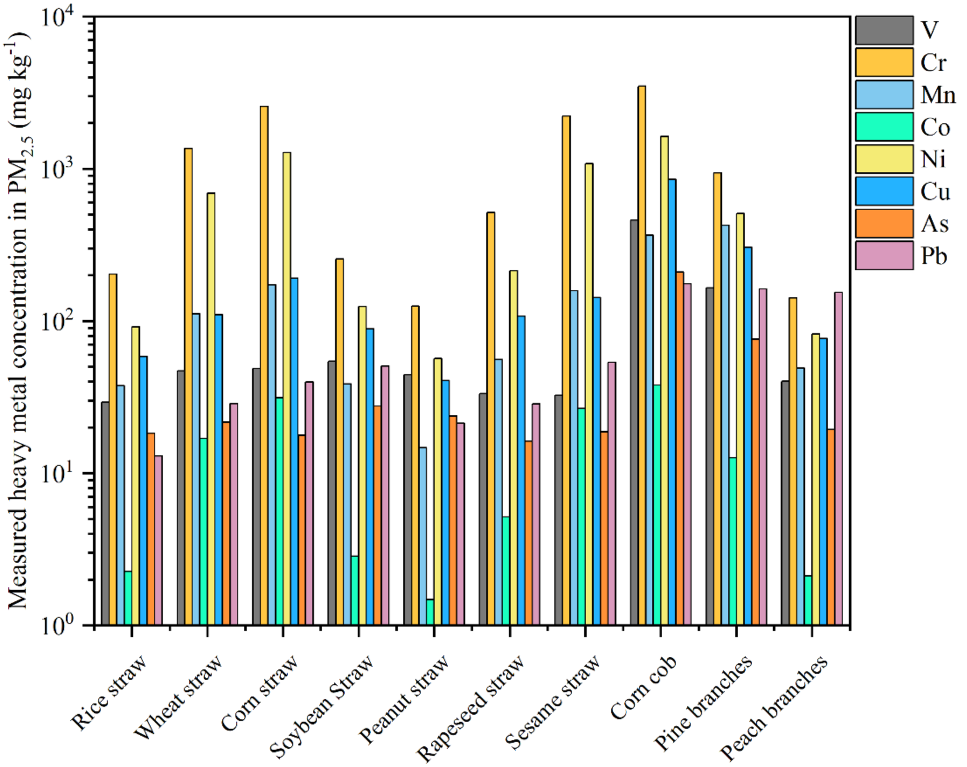


Figure S11. Heavy metal contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of domestic plant biomass burning.

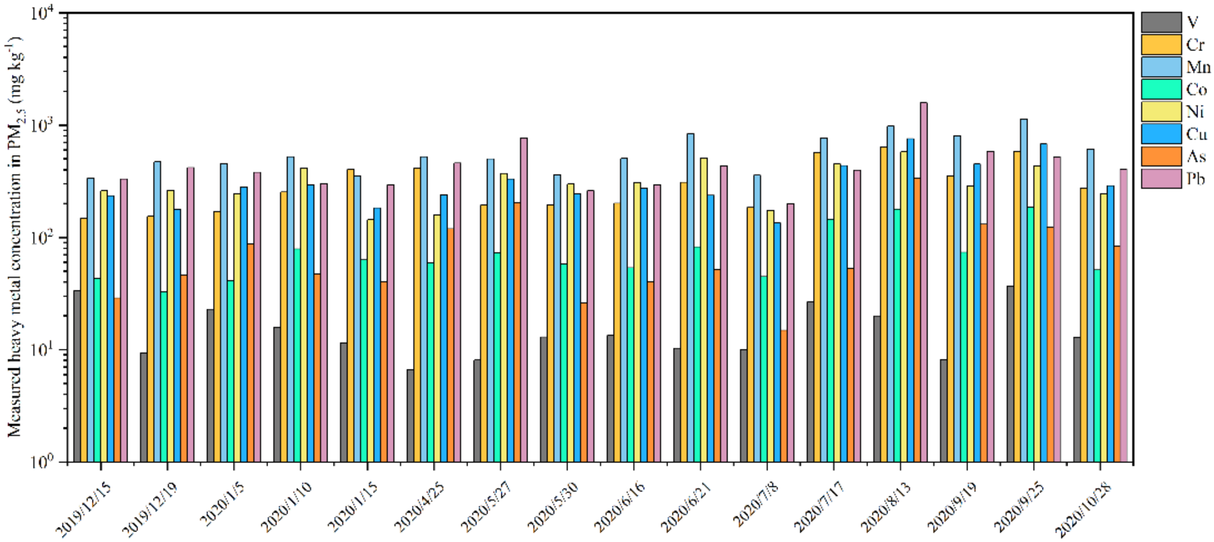


Figure S12. Heavy metal contents (mg kg^{-1}) in ambient air $PM_{2.5}$ from Nanjing city, eastern China.

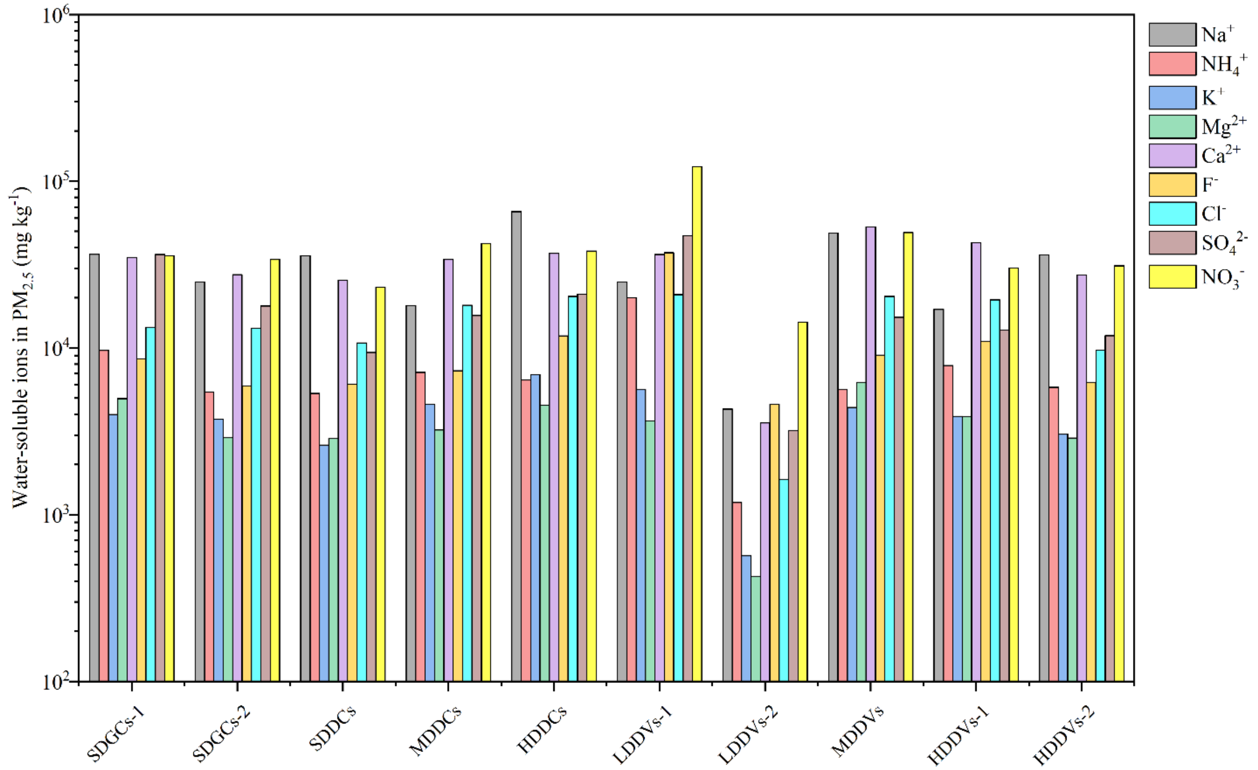


Figure S13. Water-soluble ions (WSIs) contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of automobile exhaust.

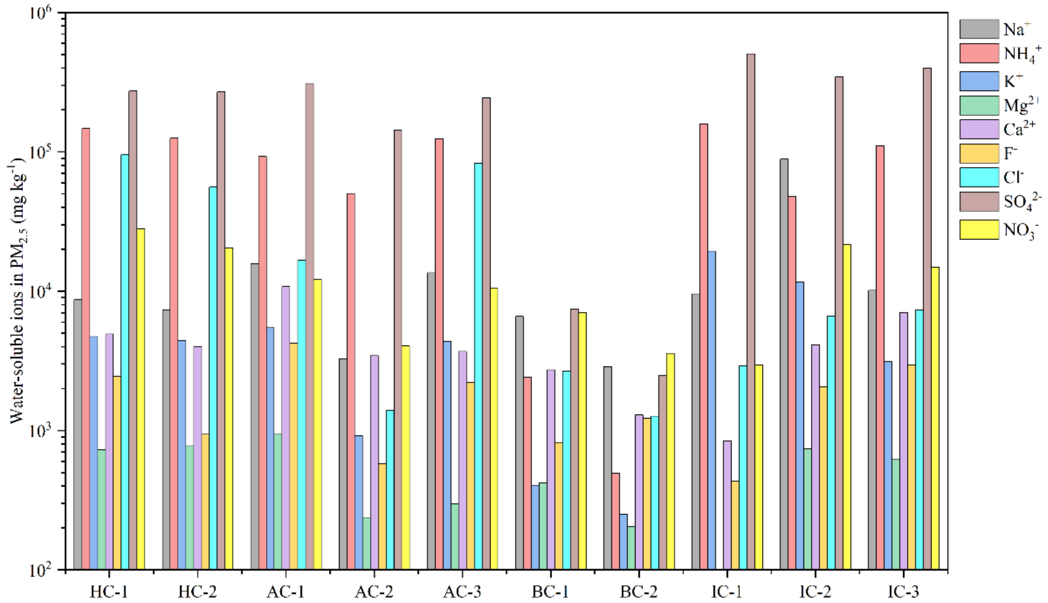


Figure S14. Water-soluble ions (WSIs) contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of coal combustion.

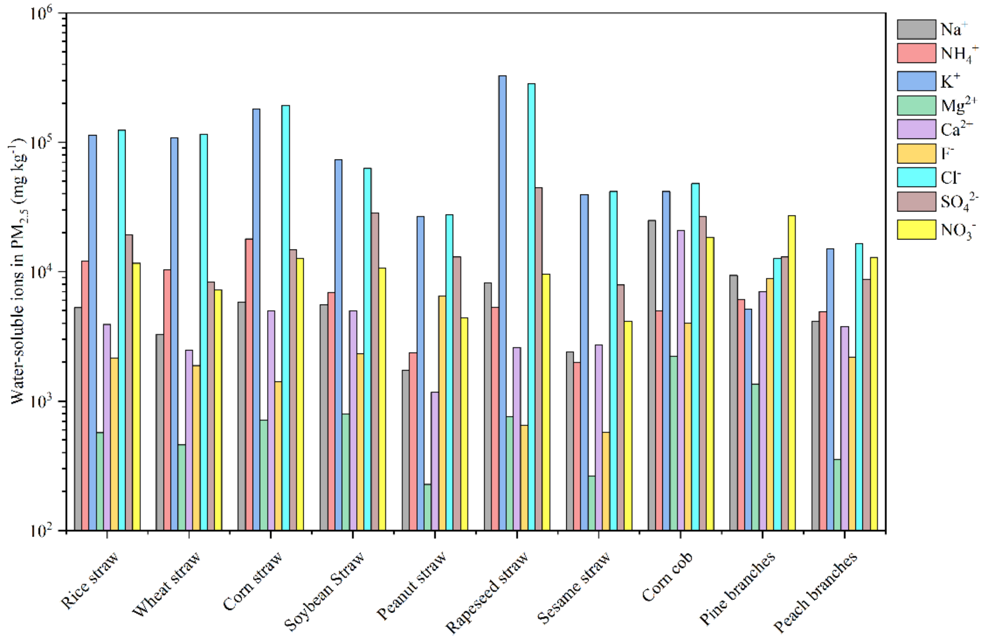


Figure S15. Water-soluble ions (WSIs) contents (mg kg^{-1}) in $PM_{2.5}$ from 10 types of domestic plant biomass burning.

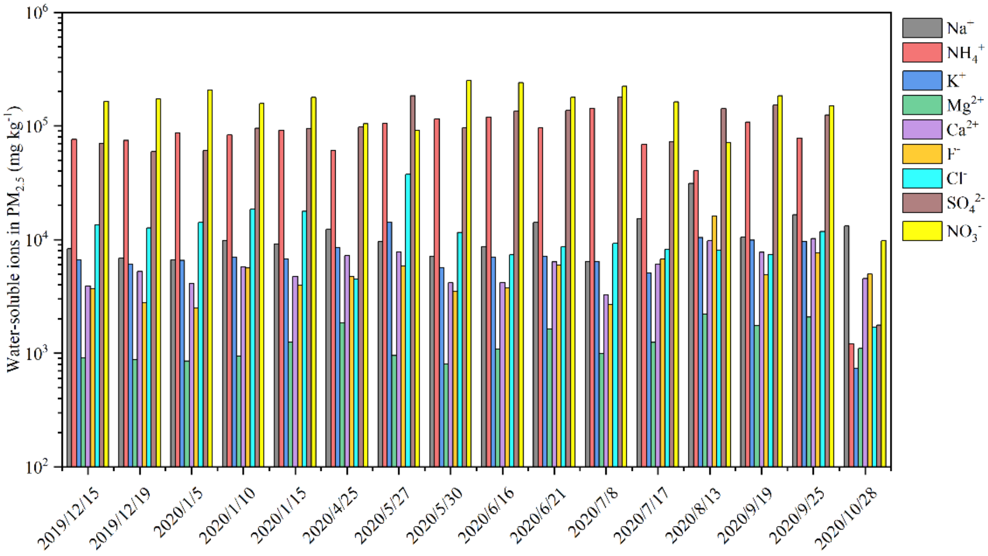


Figure S16. Water-soluble ions (WSIs) contents (mg kg^{-1}) in ambient air $PM_{2.5}$ from Nanjing city, eastern China.

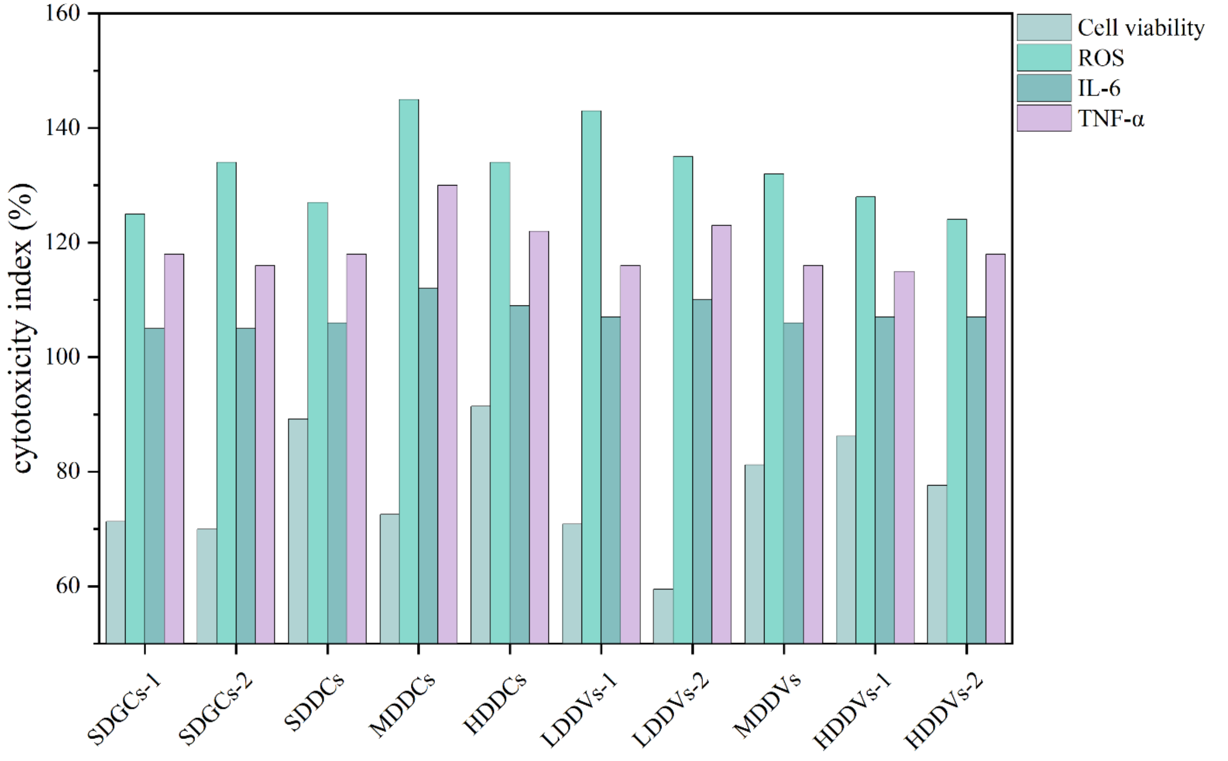


Figure S17. Cell viability, oxidative stress and inflammation levels exposed to $PM_{2.5}$ from 10 types of automobile exhaust.

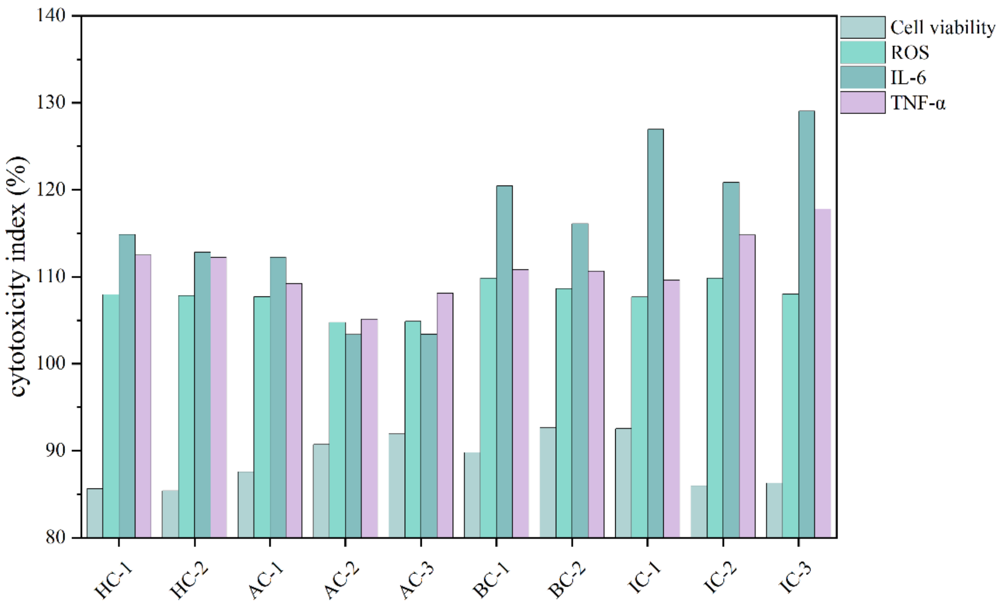


Figure S18. Cell viability, oxidative stress and inflammation levels exposed to $PM_{2.5}$ from 10 types of coal combustion.

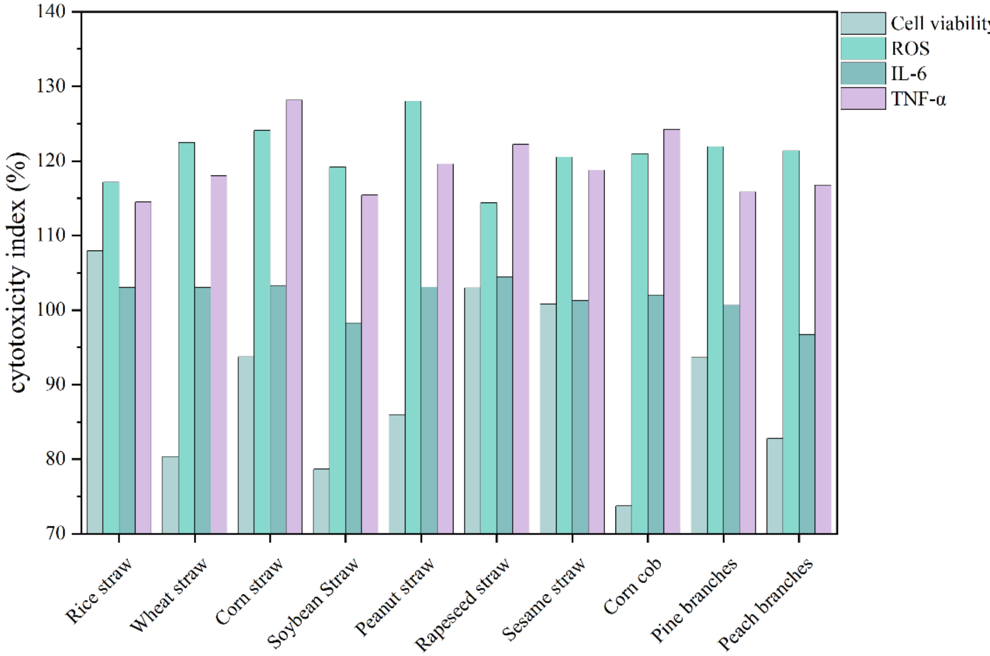


Figure S19. Cell viability, oxidative stress and inflammation levels exposed to $PM_{2.5}$ from 10 types of domestic plant biomass burning.

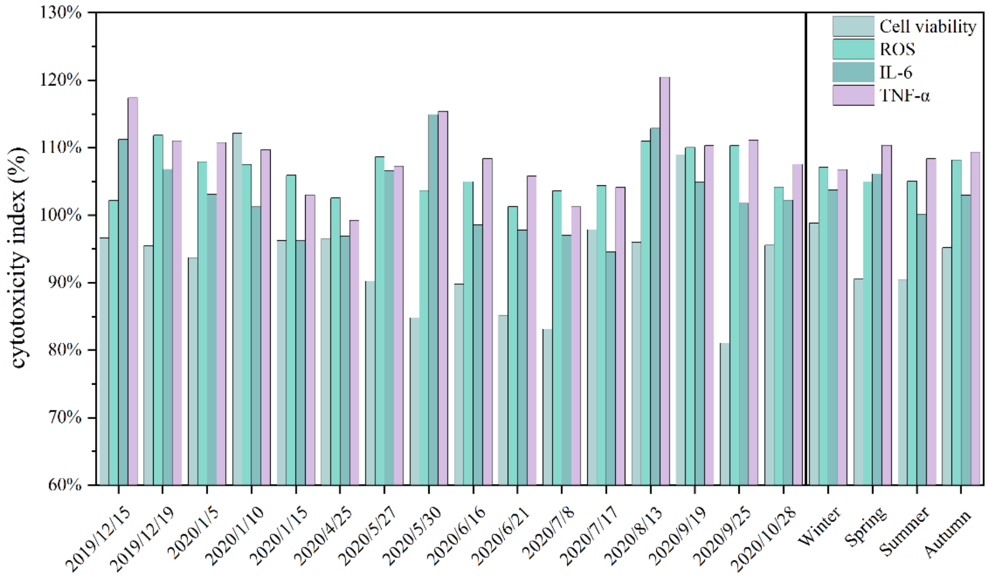


Figure S20. Cell viability, oxidative stress and inflammation levels exposed to various ambient air $PM_{2.5}$ from Nanjing city, eastern China.

Table S1. Characteristics and collection process of the investigated typical vehicles.

No.	Abbreviations	Vehicle types	Manufacture year	Emission standards	Fuel type	Collection time (min)	Weight (kg)
#1	SDGCs-1	Small duty gasoline coach	2015	CN.V	CN.92#	120	1970
#2	SDGCs-2	Small duty gasoline coach	2019	CN.VI	CN.92#	120	2110
#3	SDDCs	Small duty diesel coach	lost	CN.IV	CN.5#	20	1790
#4	MDDCs	Middle duty diesel coach	2009	CN.IV	CN.5#	20	3600
#5	HDDCs	Heavy duty diesel coach	2015	CN.V	CN.5#	20	15800
#6	LDDVs-1	Light duty diesel van	2009	CN.III	CN.5#	20	3970
#7	LDDVs-2	Light duty diesel van	2015	CN.IV	CN.5#	20	4500
#8	MDDVs	Middle duty diesel van	2014	CN.IV	CN.5#	20	7320
#9	HDDVs-1	Heavy duty diesel van	2015	CN.IV	CN.5#	20	29080
#10	HDDVs-2	Heavy duty diesel van	2019	CN.V	CN.5#	20	40000

Table S2. Characteristic analysis and collection process of typical coal samples.

Coal types	M_{ad} (%)	A_{ad} (%)	V_{ad} (%)	FC_{ad} (%)	Fuel consumption (g)	Burning duration (min)	Origin
HC-1	1.87	46.2	9.87	42.1	1169	158	Nanjing city
HC-2	2.15	49.3	9.63	38.9	1138	144	Nanjing city
AC-1	1.26	10.2	10.6	78	739	222	Ningxia province
AC-2	1.19	12.5	10.8	75.5	1024	180	Anhui province
AC-3	1.76	6.78	8.99	82.5	537	170	Shanxi province
BC-1	5.23	1.84	41.5	51.5	8117	102	Inner Mongolia province
BC-2	7.06	5.07	29.8	58	669	85	Henan province
IC-1	0.43	13	1.63	85	559	115	Nanjing Iron & Steel Co.
IC-2	1.74	11.1	30.3	56.9	601	90	China Resources Jiangsu Nanre Power Generation Co.
IC-3	4.37	8.17	30.9	56.5	652	95	Huaneng Nanjing Jinling Power Generation Co.

Note: M_{ad} is the moisture mass fraction of the sample on an air-dried basis; A_{ad} is the ash mass fraction of the sample on an air-dried basis; Vd_{ad} is volatile matter mass fraction of sample on dry air-dried basis; FC_{ad} is fixed carbon fraction of the sample on an air-dried basis; $FC_{ad} = 1 - M_{ad} - A_{ad} - Vd_{ad}$.

Table S3. Characteristic analysis and collection process of typical plant biomass fuel samples.

Biomass types	M_{ad} (%)	A_{ad} (%)	V_{ad} (%)	FC_{ad} (%)	Fuel consumption (g)	Burning duration
Rice straw	10.8	14.6	59.8	14.9	83	4′24″
Wheat straw	12.1	5.65	65.5	16.8	328	9′14″
Corn straw	11.6	4.22	66.1	18.1	108	4′39″
Soybean straw	11	4.62	68.4	16	360	11′24″
Peanut straw	15	10.8	61.4	12.8	49	1′20″
Rape straw	11.1	2.95	68.8	17.1	39	1′05″
Sesame straw	13.1	7.64	63.7	15.5	154	2′42″
Corncob	9.21	0.66	73.5	16.7	131	11′35″
Pine branches	13.4	0.33	66.6	19.7	148	12′20″
Peach branches	9.94	0.65	73.4	16	244	16′45″

Note: M_{ad} is the moisture mass fraction of the sample on an air-dried basis; A_{ad} is the ash mass fraction of the sample on an air-dried basis; Vd_{ad} is volatile matter mass fraction of sample on dry air-dried basis; FC_{ad} is fixed carbon fraction of the sample on an air-dried basis; $FC_{ad} = 1 - M_{ad} - A_{ad} - Vd_{ad}$.

Table S4 The CMB source profiles of coal combustion, plant biomass burning, automobile exhaust, and secondary sources (g/g).

Source	Coal combustion		Biomass burning		Automobile exhaust		Sulfate		Nitrate	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
OC	0.1548	0.2046	0.2828	0.1075	0.2159	0.0945	0.0000	0.0000	0.0000	0.0000
EC	0.0386	0.0609	0.1280	0.1119	0.2420	0.1589	0.0000	0.0000	0.0000	0.0000
V	0.0002	0.0001	0.0001	0.0001	0.0007	0.0011	0.0000	0.0000	0.0000	0.0000
Cr	0.0001	0.0002	0.0012	0.0011	0.0004	0.0002	0.0000	0.0000	0.0000	0.0000
Mn	0.0001	0.0001	0.0001	0.0001	0.0004	0.0003	0.0000	0.0000	0.0000	0.0000
Co	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Ni	0.0001	0.0000	0.0006	0.0005	0.0004	0.0002	0.0000	0.0000	0.0000	0.0000
Cu	0.0007	0.0006	0.0002	0.0002	0.0006	0.0002	0.0000	0.0000	0.0000	0.0000
As	0.0006	0.0008	0.0000	0.0001	0.0003	0.0005	0.0000	0.0000	0.0000	0.0000
Pb	0.0132	0.0083	0.0001	0.0001	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000
Na^+	0.0166	0.0243	0.0071	0.0064	0.0312	0.0166	0.0000	0.0000	0.0000	0.0000
NH_4^+	0.0860	0.0546	0.0073	0.0046	0.0074	0.0047	0.2730	0.0273	0.2250	0.0225
K^+	0.0055	0.0056	0.0929	0.0930	0.0039	0.0016	0.0000	0.0000	0.0000	0.0000
Mg^{2+}	0.0005	0.0003	0.0008	0.0006	0.0036	0.0015	0.0000	0.0000	0.0000	0.0000
Ca^{2+}	0.0043	0.0027	0.0055	0.0054	0.0322	0.0123	0.0000	0.0000	0.0000	0.0000
F^-	0.0018	0.0012	0.0031	0.0025	0.0108	0.0091	0.0000	0.0000	0.0000	0.0000
Cl^-	0.0273	0.0347	0.0928	0.0841	0.0148	0.0059	0.0000	0.0000	0.0000	0.0000
SO_4^{2-}	0.2504	0.1529	0.0185	0.0111	0.0191	0.0125	0.7270	0.0727	0.0000	0.0000
NO_3^-	0.0125	0.0081	0.0119	0.0065	0.0421	0.0283	0.0000	0.0000	0.7750	0.0775