Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Supporting Information:

Adsorption and Desorption Mechanism of Aromatic VOCs onto Porous Carbon Adsorbents for Emission Control and Resource Recovery: Recent Progress and Challenges

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Table S1. Aromatic VOCs emission from petroleum industry.

Emission source	Section	Representatives	Emission contribution	Ref.
Petroleum industry	Petrochemical plant	Benzene, toluene,	5.9wt%	1
	Basic chemical plant	Styrene, toluene, benzene	29.3wt%	
	Chlorinated chemical plant	Toluene, ethylbenzene, Styrene, *m/p*-xylene	29.1wt%	
	Refining area	Toluene, benzene	6.5wt%	2
	Basic chemical area	*p*-Diethylbenzene, *m*-diethylbenzene, *o*-ethyltoluene, 1,2,4-trimethylbenzene, propylbenzene, 1,3,5-trimethylbenzene	28.9wt%	
	Wastewater treatment	*p*-Diethylbenzene, 1,2,4-trimethylbenzene, *o*-ethyltoluene	12.3wt%	
	Wastewater treatment	Benzene, toluene, *m/p*-xylene	35.9vol%	3
	Coke production	Benzene, toluene, *m/p*-xylene	28.6wt%	4
		Toluene, benzene, *m*-ethyltoluene, ethylbenzene, *m/p*-xylene	43.8wt%	5

Table S2. Aromatic VOCs emission during storage and transportation.

Emission source	Section	Representatives	Emission contribution	Ref.
Storage and transportation	Organic liquids	Toluene, benzene, *m*-xylene, ethylbenzene, 1,2,4-trimethylbenzene, isopropylbenzene	54.5wt%	6
	Crude oil	*m/p*-Xylene, toluene, benzene, o-xylene, ethylbenzene	22.6wt%	
	Fuel oil	*m/p*-Xylene, toluene, benzene, ethylbenzene, o-xylene, 1,3,5-trimethylbenzene	38.7wt%	7
	Diesel oil	*m*-ethyltoluene, 1,3,5-trimethylbenzene, 1,2,3-trimethylbenzene, *p*-ethyltoluene, *o*-ethyltoluene, toluene, *m/p*-xylene, benzene	44.6wt%	

Table S3. Aromatic VOCs emission from paint manufacturing.

Emission source	Section	Representatives	Emission contribution	Ref.
Paint manufacturing	Paint solvent	Toluene, *m/p*-xylene, *o*-xylene	95.0wt%	8
	Fugitive emission	Toluene, *m/p*-xylene, ethylbenzene	24.0wt%	9
	Stacking emission	Ethylbenzene, *m/p*-xylene, toluene, styrene, *o*-xylene	39.0wt%	10
	---	*o*-Xylene, ethylbenzene, toluene, *m/p*-xylene, styrene	44.6wt%	7

Table S4. Aromatic VOCs emission from surface coating industry.

Emission source	Section	Representatives	Emission contribution	Ref.
Surface coating industry	Wood furniture industry	Ethylbenzene, o-xylene, 1,2,4-trimethylbenzene, toluene	71.1wt%	11
	Furniture painting	Ethylbenzene, *o*-xylene, 1,2,4-trimethylbenzene, *m/p*-ethyltoluene, styrene, toluene, *m/p*-xylene, 1,3,5-trimethylbenzene, n-propylbenzene	81.5wt%	4
		o-Xylene, toluene, 1,2,4-trimethylbenzene, Ethylbenzene, *m/p*-xylene, *m/p/o*-ethyltoluene, 1,3,5-trimethylbenzene, propylbenzene	87.8wt%	
	Wood furniture	*m/p*-xylene, toluene, ethylbenzene	65.2wt%	12
	Metal surface	Toluene, ethylbenzene, *m/p*-xylene	63.5wt%	
	Plastic surface	Toluene, *m/p*-xylene, ethylbenzene	39.5wt%	
	Fabric surface	Toluene, styrene, *m/p*-xylene	43.2wt%	
	Wood furniture	Styrene, ethylbenzene, toluene, *m/p*-xylene, *o*-xylene, m-ethyltoluene	60.4wt%	10
	Metal surface	Toluene, ethylbenzene, *m/p*-xylene, styrene, *m*-ethyltoluene	51.2wt%	
	Auto painting	*m/p*-Xylene, ethylbenzene *o*-xylene, toluene, 1,2,4-trimethylbenzene, *o/m/p*-ethyltoluene	93.5wt%	9
	Water-based emulsion Paint	1-ethyl-3-methylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, propylbenzene, *o*-xylene, toluene	72.9wt%	13

Ship manufacture	xylenes	22.13wt%	7
	m/p-Xylene, ethylbenzene, *o*-xylene	91.6wt%	12
Automobile manufacture	Toluene, ethylbenzene, *p*-xylene	48.3wt%	14
Truck manufacture	Ethylbenzene, *o*-xylene, *p*-xylene, 1-ethyl-3-dimethylbenzene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene	34.0wt%	
Automobile manufacture	Ethylbenzene, styrene, xylene, toluene, benzene	43.4wt%	15
	Ethylbenzene, xylene, toluene, styrene, benzene	43.2wt%	16
	Toluene, benzene	46.5wt%	17
	Benzene, m/p-xylene 1,2,4-trimethylbenzene	67.0wt%	12

Table S5. Aromatic VOCs emission from printing industry.

Emission source	Section	Representatives	Emission contribution	Ref.
Printing industry	Offset printing facility	1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, propylbenzene, *o*-xylene, isopropylbenzene, *p*-xylene, *p*-isopropytoluene, *sec*-butylbenzene	99.1wt%	18
	Print plant	1,2,4-trimethylbenzene, ethylbenzene, *m*-ethyltoluene, *m/p*-xylene, *o*-xylene, *p*-ethyltoluene, toluene	47.4wt%	4
	Flexographic printing	*o*-Xylene	35.5wt%	14
	Letterpress printing	Ethylbenzene, *m/p*-xylene, toluene, styrene, benzene	51.1wt%	10
	Printing ink	*m/p*-Xylene, ethylbenzene, *o*-xylene, toluene	31.8wt%	19
	Printing factory	*m/p*-Xylene, toluene, 1,2,4-trimethylbenzene, *p*-diethylbenzene	31.6wt%	20

Table S6. Aromatic VOCs emission from other source profiles.

Emission source	Section	Representatives	Emission contribution	Ref.
Medicine producing	Wastewater treatment	Toluene, *m/p*-xylene, ethylbenzene	46.5wt%	9
	Producing lines	Toluene, *m/p*-xylene, ethylbenzene, *o*-xylene, benzene	15.0wt%	
	Centrifugation	Toluene, *m/p*-xylene, ethylbenzene	9.6wt%	
Plastic producing	Polypropylene	*m/p*-Xylene, ethylbenzene, *o*-xylene, toluene	97.6wt%	
	Polyethylene	*m/p*-Xylene, ethylbenzene, *o*-xylene, toluene	98.8wt%	
Synthetic rubber/fiber	Butadiene styrene rubber	Styrene, benzene, *m/p*-xylene, ethylbenzene	26.0wt%	21
	Cellulose acetate fiber	Toluene, benzene, ethylbenzene, *m/p*-xylene	27.3wt%	
Manufacture of Chemical raw materials	---	*m/p*-Xylene, *o*-xylene, toluene, ethylbenzene, benzene, 1,2,4-trimethylbenzene	28.0wt%	
Boiler	Coal combustion	Benzene, toluene, ethylbenzene, *m/p*-xylene, *o*-xylene	29.1wt%	7
	Fuel oil combustion	Benzene, toluene	12.8wt%	
	Natural gas combustion	Benzene, toluene, *m/p*-xylene, ethylbenzene	72.0wt%	
	Liquefied petroleum gas	Styrene, benzene, toluene, *m/p*-xylene	85.1wt%	
	Waste	*m/p*-Xylene, *o*-xylene, ethylbenzene	37.9wt%	
Shoemaking	Fugitive emission	Toluene	25.5wt%	10

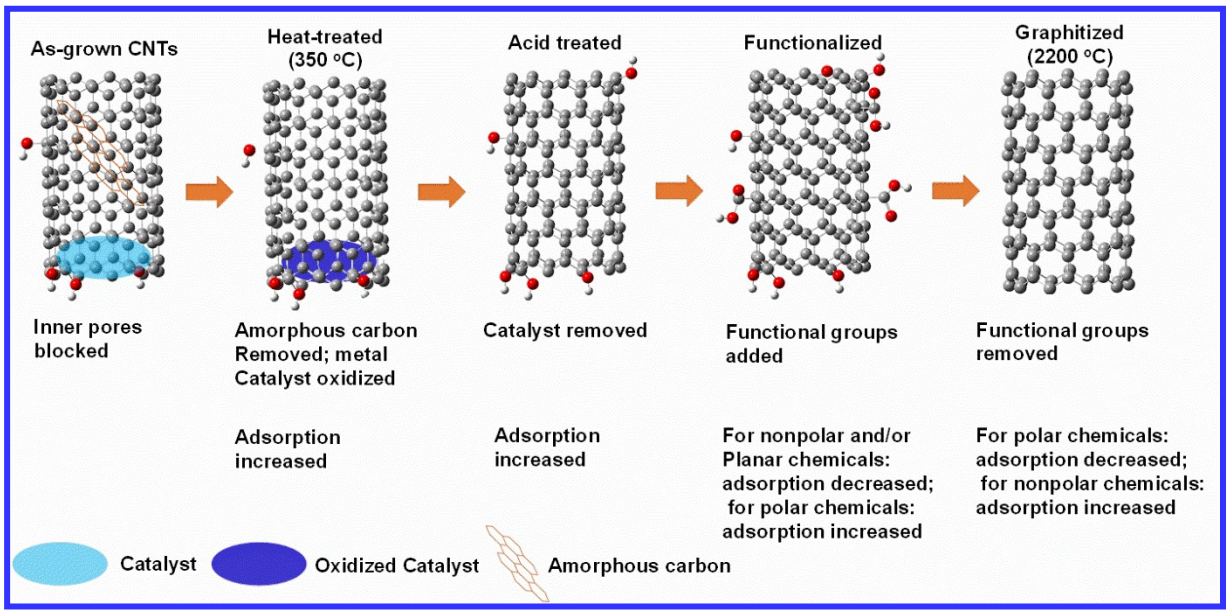

Fig. S1 Adsorption properties as affected by CNT functional groups. This figure shows the general trend for the changes of CNT adsorption properties after different treatments. The surfaces of raw CNTs are hydrophobic as is demonstrated by the strong preference for the adsorption of hydrocarbons (such as hexane, benzene, and cyclohexane) over alcohols (such as ethanol, 2-propanol). Functionalization will lead to increased oxygen content, decreased surface area, and reduced adsorption of nonpolar hydrocarbons due to reduced hydrophobicity, and so will planar chemicals due to insufficient contact between CNT and the chemical. Graphitization will eliminate functional groups, and decrease the adsorption of polar chemicals, but will increase the adsorption of nonpolar and/or planar hydrocarbons (adapted with permission from ref. 22. Copyright 2008 American Chemical Society.)

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