Superior Post-Combustion CO_2 Adsorption from Waste Coffee Ground Derived Carbons

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Supporting Information

Table S1. CO_2 uptake capacities for leading porous solid sorbents

Material	CO_2 Uptake* (mmol/g)	Methodology	Reference
Mg-MOF-74	6.2	Metal Organic Frameworks (MOFs)	1
Co-MOF-74	5.6		1
Ni-MOF-74	5.4		1
Zn-MOF-74	4.0		2
HKUST-1	4.2		3
CuTATB-60	3.6		4
TiC-CDC	4.1	Synthesised from Titanium carbide powder	5
IBN9-NC1-A	4.5	Hard-template approach using a sacrificial zeolite template	6
KNC-A-K	4.0		7
YTC7	2.4		8
ATS-4-700	3.4		9
CHEM750	4.4		10
ACM-5	5.1	Polymer synthesised for carbon precursor	11
ACM-3	4.3		11
K-PAF-1-750	4.2		12
CCI-30	3.5		13
CS-6-CD-4	4.5		14
AC-750-0.5	4.3		15
STC-R-500-A	4.4		16
PAN-PK	4.4		17
600-2	4.8		18
NPC-650	3.1		19
AG-2-700	4.5	Naturally existing biomass and waste materials	20
AS-2-600	4.8		21
CG-400-2	4.2		This work
CG-700-2	4.4		This work
a-CL	4.3		22
PA-400-KOH-2-600	4.2		23
AC-2-635	3.8		24
AC-1	2.9	Activated Carbons	25
Norit R1	2.1		26
Maxsorb	1.9		27
Activated Carbon A	1.9		26
BPL	2.1		28

*CO_2 uptakes reported at 25 °C and 1 bar, when not directly reported, the uptake values have been taken from adsorption isotherms in the corresponding reference.

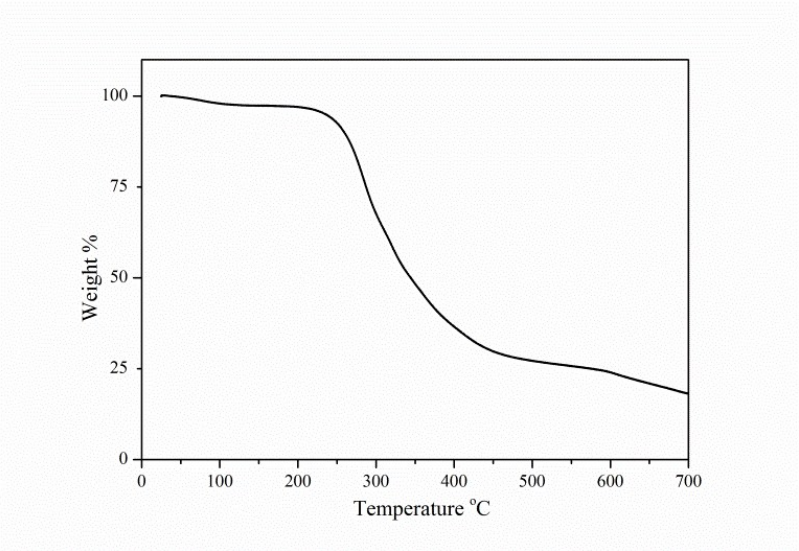
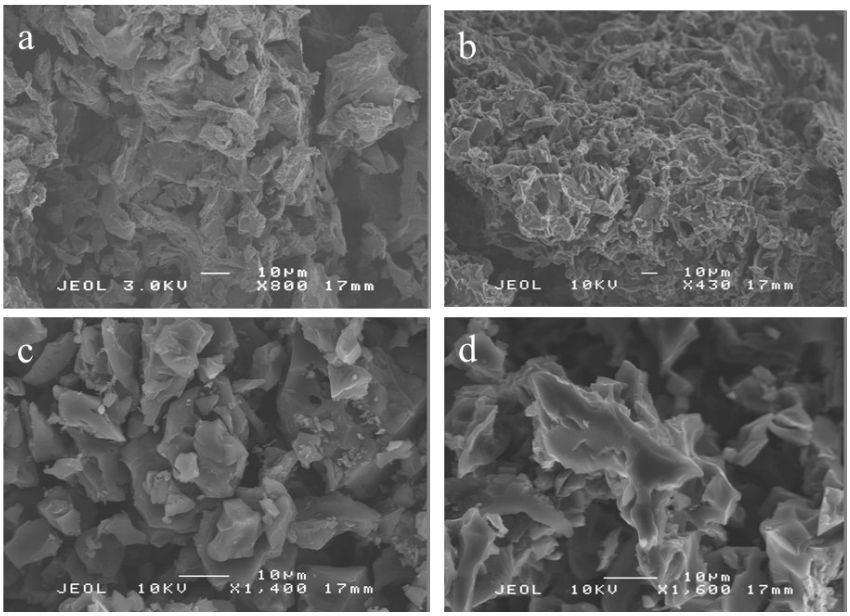


Figure S1. Thermogravimetric analysis for dried coffee grounds to up to 700 °C. Heating at 2°C/min under Argon.



FigueS2.SEM analysis: (a, b) CG char pyrolysed at 400 and 700 °C respectively and (c, d) 4-1 KOH activation for CG 400 and CG 700 respectively.

Table S2. Elemental analysis and yield

Material	atomic % [a]		Yield (g/100 g CG)
	C	O	
CG 400	88.3	9.7	30.3
CG 700	89.9	7.1	26.2
CG 400 2-1	85.1	14.8	16.3
CG 400 4-1	86.9	13.0	11.8
CG 700 2-1	78.2	20.8	14.4
CG 700 4-1	90.8	9.1	12.6

[a]atomic % from XPS elemental analysis.

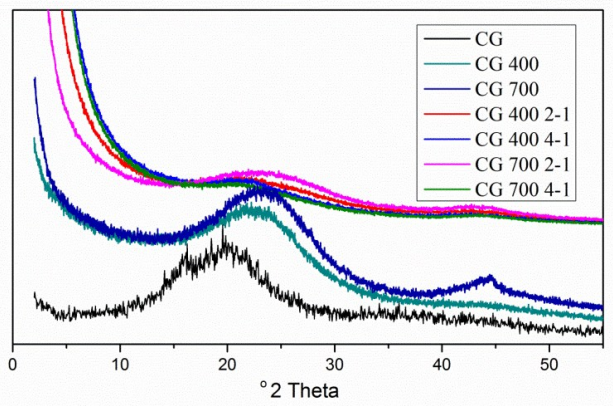


Figure S3. X-Ray Diffraction pattern (XRD) for the Coffee ground starting material, 400 and 700 °C chars and the activated carbon products

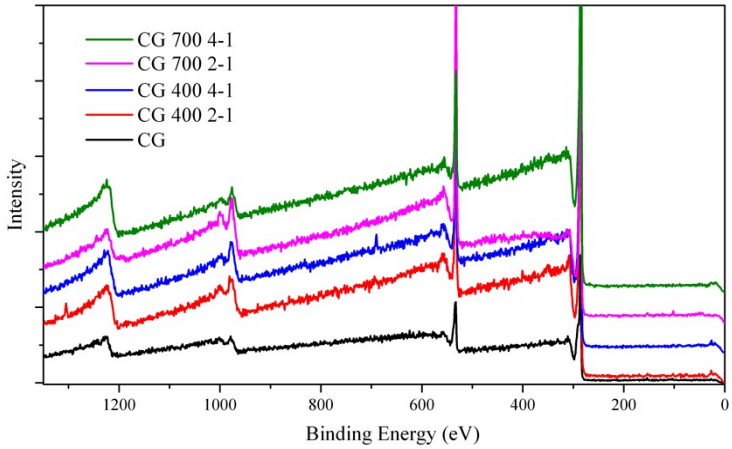


Figure S4.XPS Survey analysis of coffee grounds and the KOH activated Coffee Grounds derived carbon.

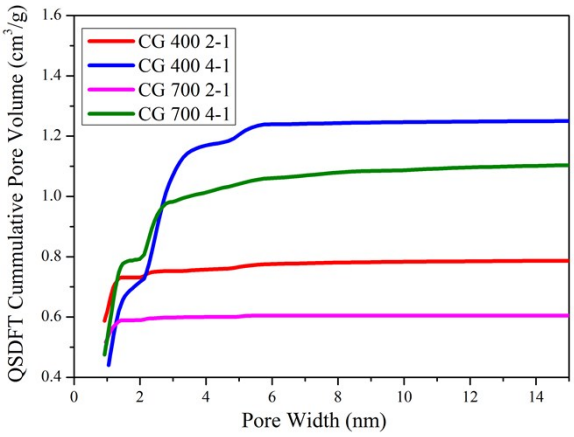


Figure S5.QSDFT Cumulative pore volume for KOH treated Coffee Grounds

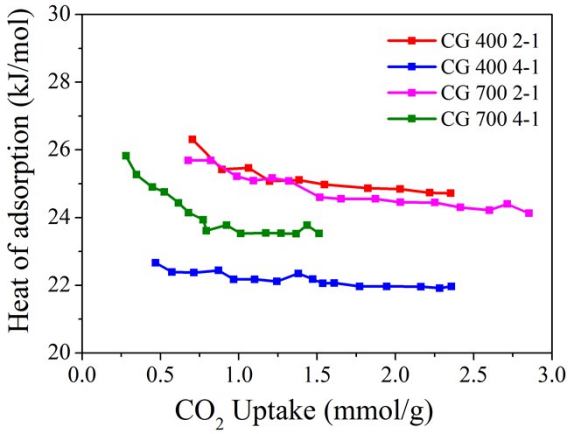


Figure S6.Isosteric heat of adsorption for the activated carbon products

Table S3. CO_2 capture data at 25 °C and 0.15 bar for materials in this work and literature

Material	Uptake (mmol/g)	Reference
CG 700 2-1	1.33	This Work
CG 700 4-1	1.01	This Work
CG 400 2-1	1.06	This Work
CG 400 4-1	0.61	This Work
Carbon from bean dreg	1.20	10
AC-750-0.5	1.38	15
$[Zn_2(bttb)(py\text{-}CF_3)_2]$	0.20	29
$[Zn_2(bttb)]$	0.40	29
ZIF-8	0.09	30
ZIF-8 24h@500 °C	0.40	30

Table S4. Highest values of CO_2 capture at 50 °C and 1 bar for porous carbons reported in the literature

Material	Uptake (mmol/g)	Reference
CG 700 2-1	2.9	This Work
COM-15	2.3	13
YTC7	1.4	8
AC-2 365	2.6	24
ATS-2-700	2.1	9
AG-2-700	2.8	20
AS-2-600	3.6	21
CP-2-800	2.1	31

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