Support Information

Fly ash derived calcium silicate hydrate as a highly efficient and fast adsorbent for Cu(II) ions: roles of copolymer functionalization

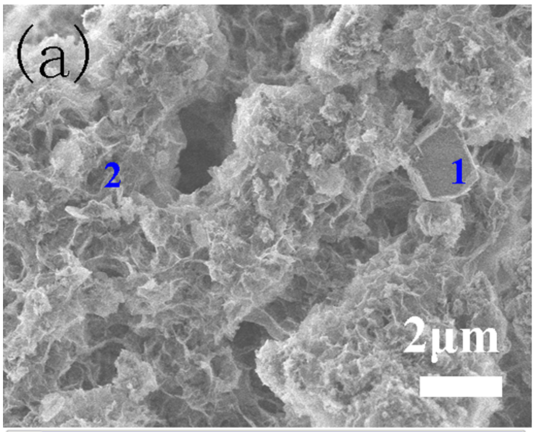
Shengrui Sun,[a,b] Ya Tang,[a,c] Jiayi Li,[a] Jiahui Kou,[*,c] and Yangqiao Liu[*,a,b]

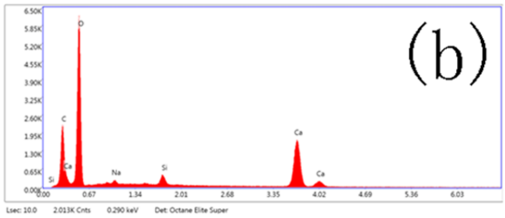
[a]Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai 200050, China

[b]Jiangsu Research Institute of Advanced Inorganic Materials, Taicang 215488，China

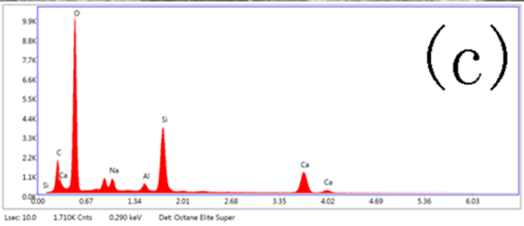
[c]College of Materials Science and Engineering, Nanjing Tech University, Nanjing211816, China

[*] Corresponding authors

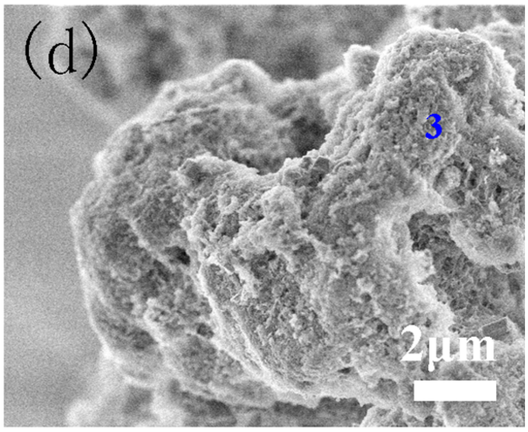


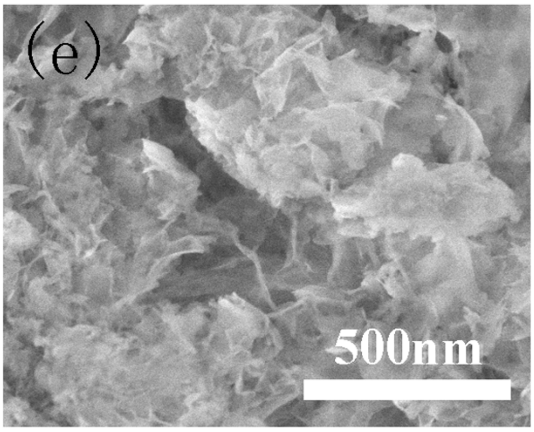


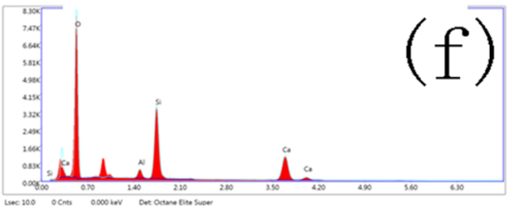
Element	Weight %	Atomic %
C K	10.84	18.48
O K	45.49	58.20
NaK	1.43	1.27
SiK	2.17	1.58
CaK	40.06	20.46



Element	Weight %	Atomic %
C K	9.91	16.27
O K	45.91	56.58
NaK	4.74	4.07
AlK	1.64	1.20
SiK	15.58	10.94
CaK	22.21	10.93







Element	Weight %	Atomic %
O K	51.44	69.06
AlK	2.23	1.77
SiK	18.94	14.49
CaK	27.39	14.68

Figure S1 SEM (a) and EDS (b-c) of CSH(b and c corresponding to point 1 and 2, respectively); SEM (d-e) and EDS(f) (corresponding to point 3) of ACSH

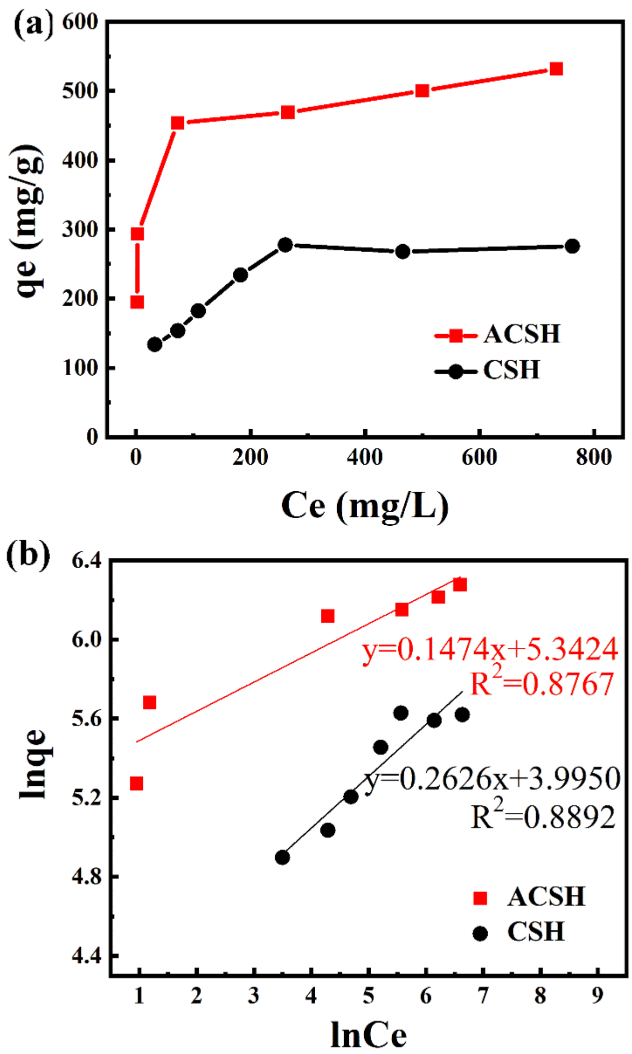


Figure S2 (a) Isothermal adsorption and (b) linearized fitting curves of Freundlich model.

Table S1 Chemical components of raw fly ash and desilication fly ash.

wt%	SiO_2	Al_2O_3	Fe_2O_3	CaO	TiO_2	MgO	Na_2O	SO_3	Total
Raw fly ash	48.25	24.04	6.41	11.25	1.12	1.47	1.54	2.72	96.80
Desilication fly ash	38.63	24.83	8.78	15.18	1.24	1.64	8.028	0.06	98.39

Table S2 Chemical components of desilication solution.

mg/(fly ash g)	Si	Al	Fe	Ca	Mg	Na
Desilication solution	86.3	9.9	0.05	0.12	0.01	902.1

Table S3.Fitting parameters for Ca 2p of CSH and ACSH samples.

			CSH	ACSH
Ca 2p 3/2	**Ca-Si-O**	**Peak BE[a] (eV)**	347.1	346.8
		FWHM[b] (eV)	1.79	2.05
		Area %	149712	201430
	$CaCO_3$	**Peak BE[a] (eV)**	346.7	/
		FWHM[b] (eV)	1.55	/
		Area %	64902	/
Ca 2p 1/2	**Ca-Si-O**	**Peak BE[a] (eV)**	350.7	350.4
		FWHM[b] (eV)	1.81	2.12
		Area %	71856	100715
	$CaCO_3$	**Peak BE[a] (eV)**	350.3	/
		FWHM[b] (eV)	1.5	/
		Area %	32452	/

a:Binding Energy

b:Full Width Half Maximum

Table S4 Comparison of various reported adsorbents with ACSH for Cu(II) Adsorption

Adsorbent type	**Adsorption capacity (mg/g)**	**Temperature （K）**	**Initial pH of Cu(II) solution**	**BET surface (m^2/g)**	**Ref.**
activated carbon	10.00	Not mentioned	Not mentioned	921	[1]
walnut shell ash/starch/Fe_3O_4	45.40	Not mentioned	6	53	[2]
sodium alginate grafted polyacrylamide/graphene oxide hydrogel	68.76	298	5	2	[3]
calcium silicate hydrate from coal gangue	70.42	313	6	24	[4]
Mg/Al layered double hydroxides	137.00	303	5	8	[5]
mesoporous silica	153.00	298	6	462	[6]
alginate@polyethylenimine	163.70	Not mentioned	4.5	19	[7,8]
PEI-functionalized calcium silicate hydrates	203.25	298	4	88	[9]
ethylenediamine tetramethylene-phosphonic acid / UiO-66	210.89	298	5.5	131	[10]
humulus scandens-derived biochars	221.00	298	5	450	[11]
resin based amorphous molybdenum Sulphide	259.00	293	Not mentioned	28	[12]
N-methylene phosphonic chitosan aerogels	276.12	298	5	491	[13]
calcium silicate obtained by template method	389.85	293	Not mentioned	239	[14]
chitosan-coated calcium silicate hydrate	425.00	Room temperature	6	356	[15]
CSH	278.00	293	5	240	This work
ACSH	532.00	293	5	356	This work

Table S5 Comparison of various reported adsorptive membranes for Cu(II) Adsorption

Adsorbent type	**Flux (L*m²/h)**	**Concentration of Cu(II) (mg/L)**	**Rejection (%)**	**Ref.**
Modified CNTs-ceramic membrane	~23	100	77	[16]
Polysulfone added with Bentonite	46	5	59	[17]
Polysulfone added with Sepiolite	144	5	22	[17]
Polysulfone added with Zeolite	126	5	97	[17]
3-Aminopropyltriethoxysilane modified alumina membranes	Not mentioned	20	87	[18]
ZIF-8 membranes on alumina hollow fiber support	133	10	90	[19]
ACSH based membrane	~143	20	94	This work

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