

Chemical Recycling of Used Motor Oil by Catalytic Cracking with Metal-Doped Aluminum Silicate Catalysts

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S.1. Characterization of catalysts

EDS: energy-dispersive X-ray spectroscopy was carried out to confirm the presence of metal constituents on synthesized catalysts. As expected, Al, Si and Cu were detected, as depicted in Figure S1.

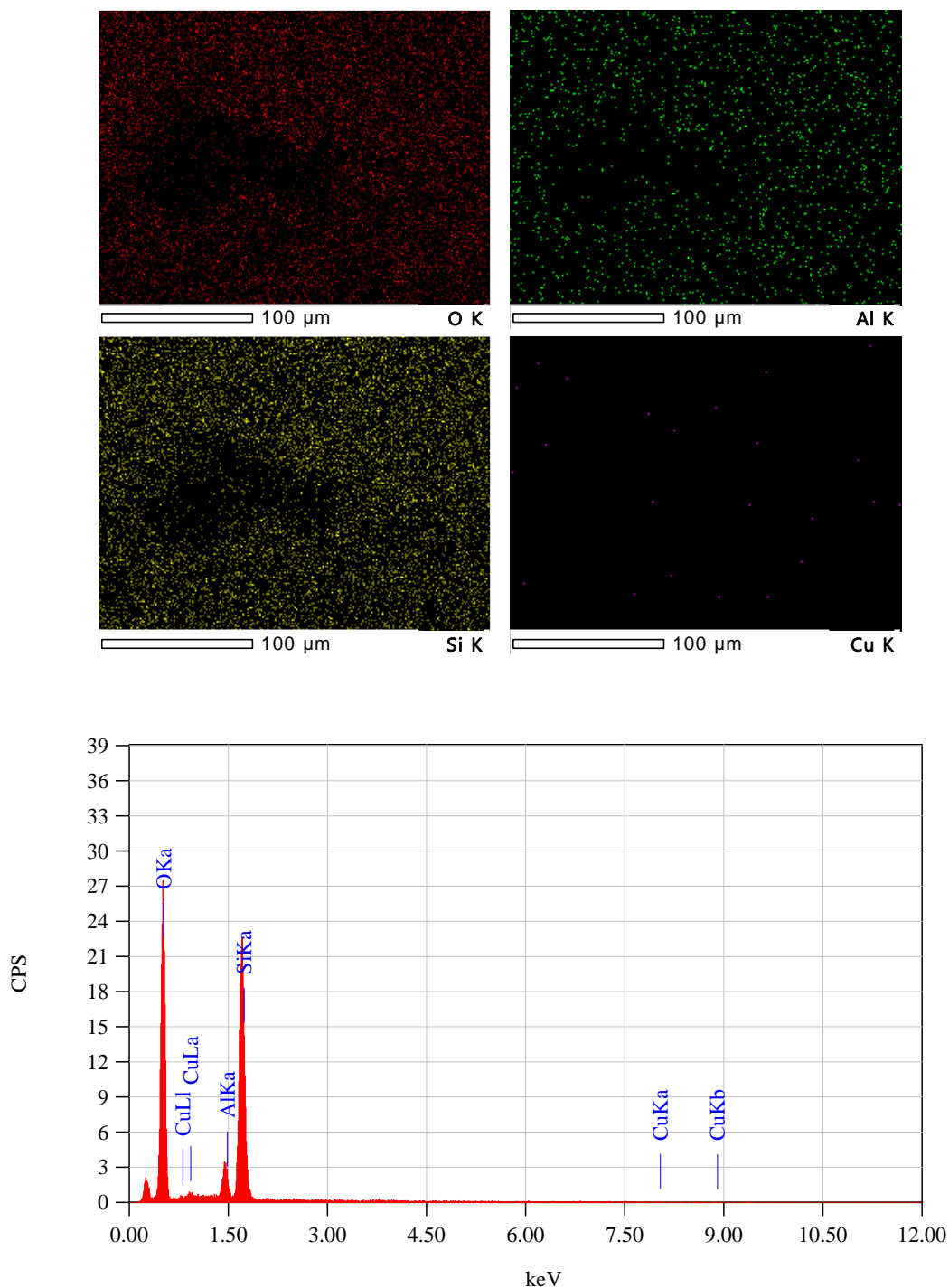


Figure S1. Scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDX) analysis (+) of a Cu-doped aluminosilicate.

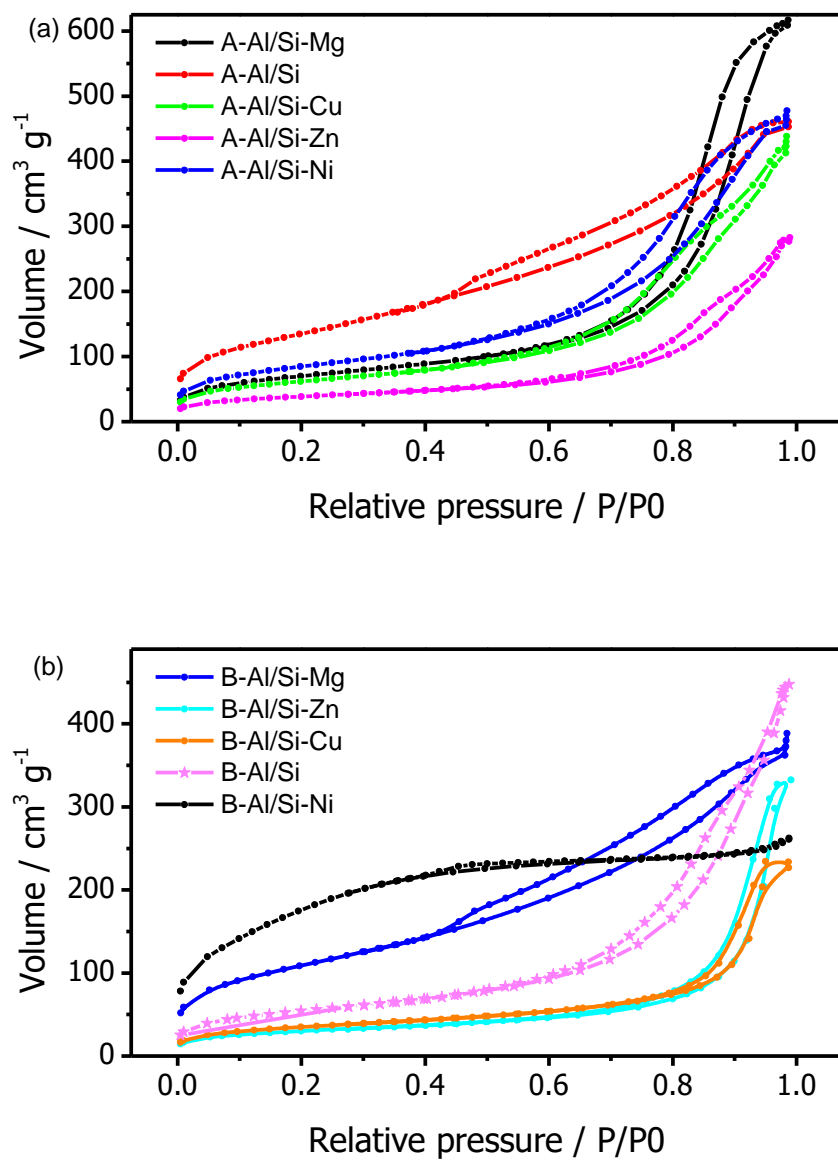


Figure S2. N₂ adsorption-desorption isotherms of synthesized materials. a) acid and b) basic preparation.

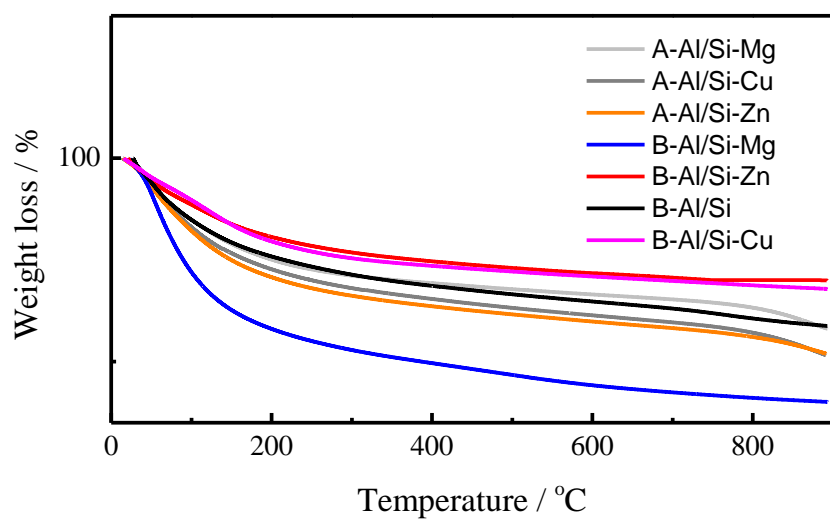


Figure S3. Thermal gravimetric analyses of synthesized materials.

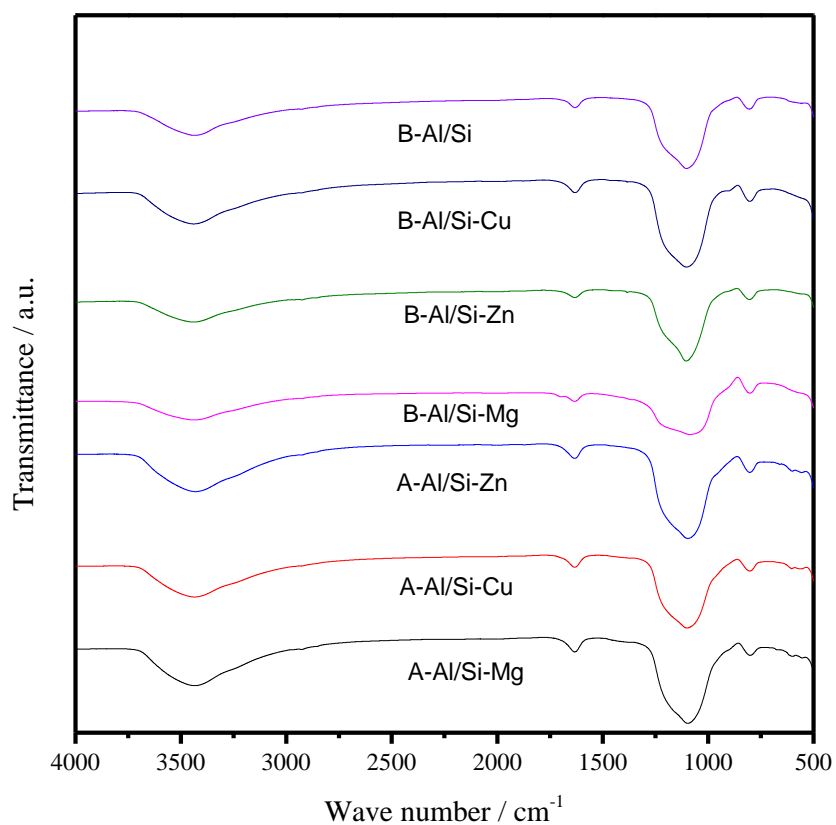


Figure S4. Infrared spectra of synthesized materials.

Table S1. Mass balance of thermal and acidic/basic catalytic cracking process.

Reactor temperature (°C)	m ₀ (g)	m _G (g)	m _R (g)	m _L (g)
Thermal cracking				
380	87.02	2.84	81.90	2.28
385	86.03	2.26	78.77	5.00
390	88.97	3.55	75.18	10.23
380	89.74	4.57	81.41	3.76
385	90.11	3.49	80.56	6.06
390	88.02	5.87	69.91	12.25
Basic catalytic cracking				
380	85.04	2.41	81.53	1.10
385	82.27	2.61	76.52	4.04
390	88.29	1.46	67.58	19.26

Table S2. Mass balance of acidic/basic catalytic cracking process doped with different metals.

Reactor temperature (°C)	Metal	m ₀ (g)	m _G (g)	m _R (g)	m _L (g)
Acid catalyst					
385	MgCl	84.81	1.86	69.69	13.26
390		81.72	1.61	58.50	21.57
385		84.42	0.01	69.48	14.92
390	Zn	83.81	23.69	30.54	29.58
385	Cu	82.57	0.96	71.33	10.28
390		84.02	2.57	62.17	19.28
385		86.72	2.49	73.59	10.65
390	Ni	83.16	0.12	66.43	16.60
basic catalyst					
385	MgCl	83.79	0.81	73.57	9.41
390		84.70	11.88	41.25	31.58
385		91.14	0.95	71.26	18.93
390	Zn	79.81	6.39	42.63	30.78
385	Cu	86.10	2.72	72.28	11.10
390		82.35	1.06	41.07	40.21
385		79.04	2.70	62.54	13.79
390	Ni	78.89	2.23	26.43	50.23