Electronic supplementary information

Production of hollow and porous Fe_2O_3 from industrial mill scale and its potential for large-scale electrochemical energy storage applications

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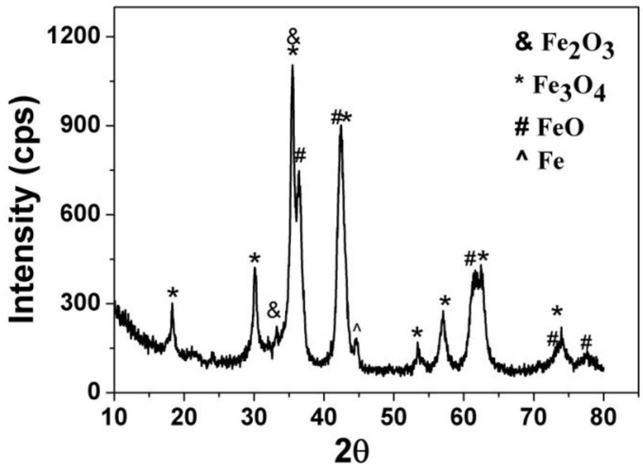

Figure S1: XRD pattern of the as-supplied mill scale

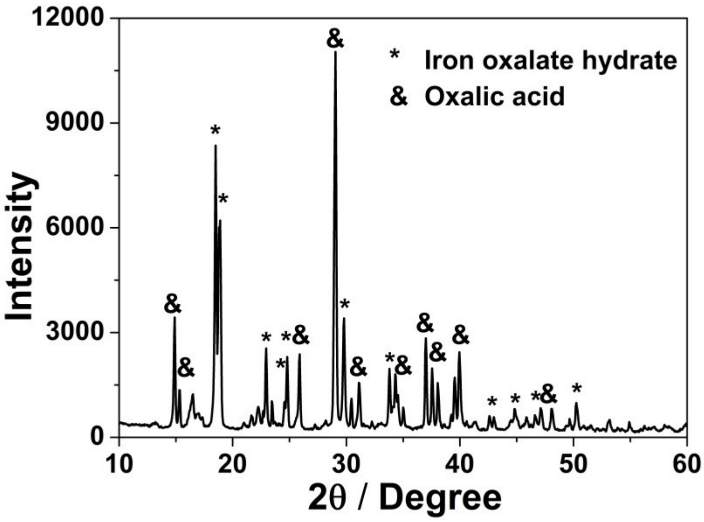

Figure S2: XRD pattern of the product after reaction of the mill scale with oxalic acid.

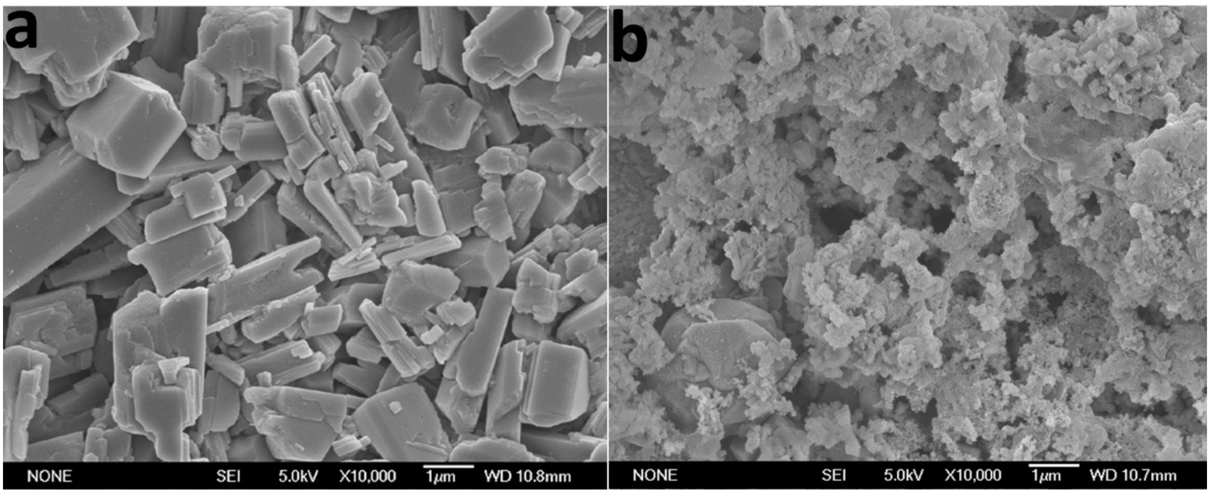

Figure S3: SEM images of the products after reaction of mill scale with (a) oxalic acid and (b) HCl.

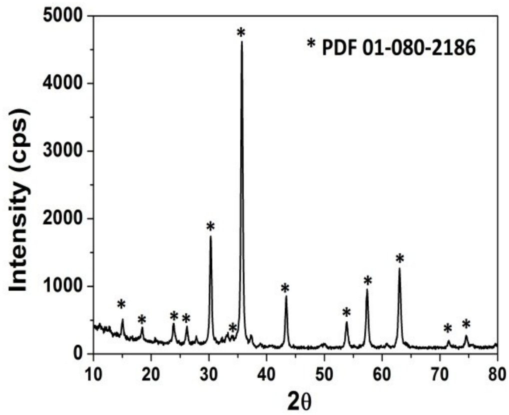

Figure S4: XRD pattern of the product obtained after calcination at 400 ^{o}C for 2 hrs.

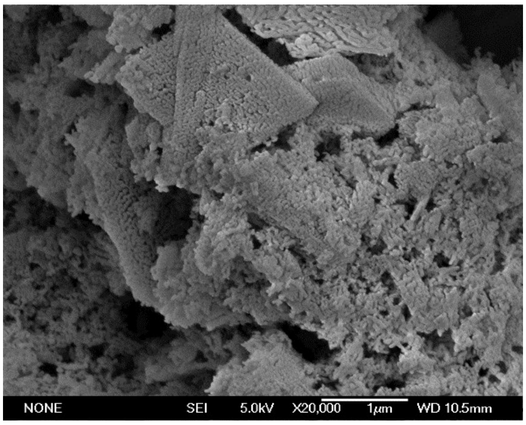

Figure S5: SEM image of the product obtained after calcination at 800 ^{o}C for 2 hrs.

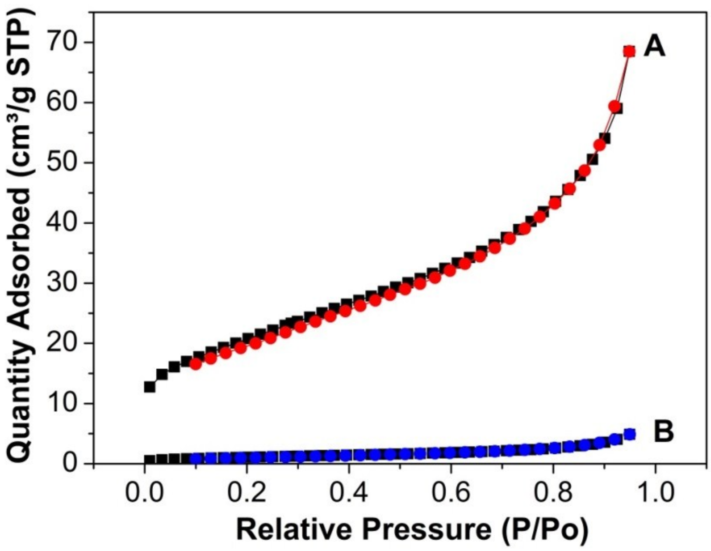

Figure S6: N_2 adsorption-desorption isotherms of the feedstock mill scale powder after 4 hr ball milling (B) and then the hollow and porous Fe_2O_3 powder after chemical and heat treatment (A).

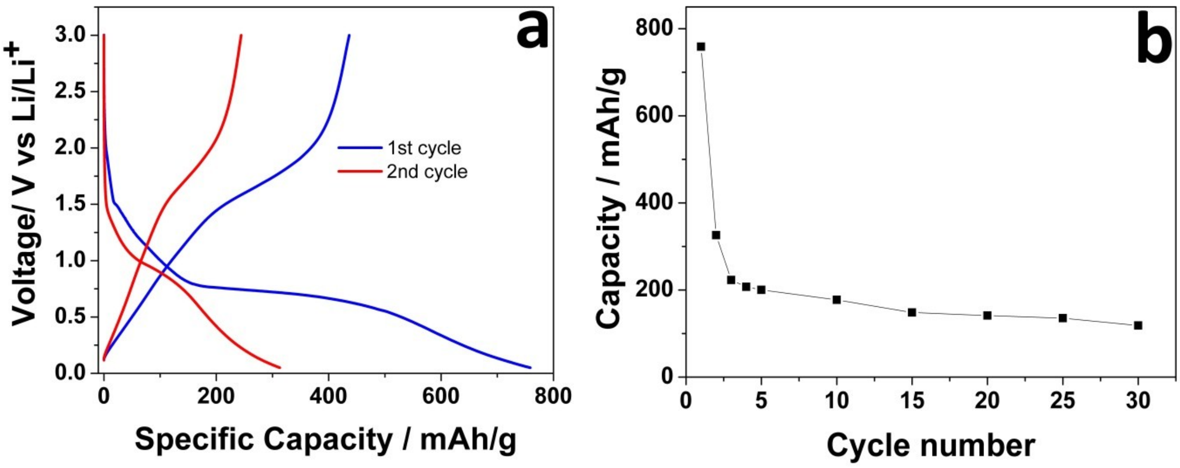

Figure S7: (a) Charge/discharge curves at 0.1 C of the ball milled mill scale powder and (b) specific capacity as a function of cycle number.

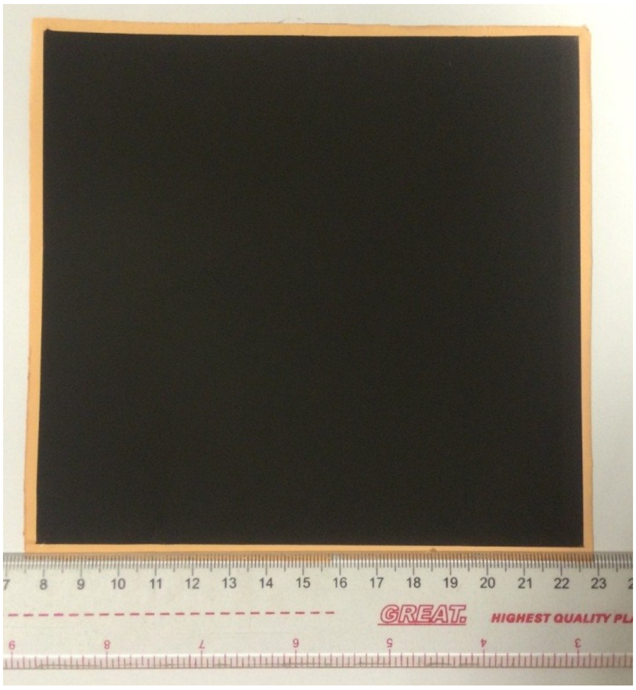

Figure S8: Photograph of a 15 cm x 15 cm sprayed electrode on a Cu foil current collector

Table S1: Specific capacitances of iron oxides reported in the recent literature.

Electrodes	**Electrolyte**	**Specific capacitance F/g**	**Current density or scan rate**	**Reference**
Fe_2O_3 nanostructure	Na_2SO_4	90	10 mV/s	[1]
Fe_2O_3 porous fiber	LiOH	256	1 mV/s	[2]
Fe_2O_3 nanograin	LiOH	102	1 mV/s	[2]
Porous Fe_2O_3 nanostructures	Na_2SO_3	127	1 A/g	[3]
Fe_2O_3 sheets	Li_2SO_4	147	0.36 A/g	[4]
Porous Fe_2O_3	Na_2SO_3	193	1 A/g	[5]
Fe_3O_4 nanowires	Na_2SO_3	70	1 A/g	[6]
Fe_3O_4 nanorods	Na_2SO_3	40	1 A/g	[6]
Fe_3O_4 nanosheets	Na_2SO_3	83	0.42 A/g	[7]
Fe_3O_4/FeOOH nanowire	Na_2SO_3	300	2 mV/s	[8]
Fe3O4 thin film	Na_2SO_3	118	2 A/g	[9]
Hollow and porous Fe_2O_3	Na_2SO_3	346	2 mV/s	This work
		213	2 A/g	

Table S2. Specific capacity and cycle life of Fe_2O_3 anodes reported in the recent literature

Electrodes	**Stable capacity (mAh/g)**	**C-rate (A/g)**	**Cycle life Retained (mAh/g)**	**First efficiency**	**Reference**
3D network Fe_2O_3	852	0.2	1105@100 cycles	75%	10
	520	5			
Nano-Fe_2O_3	926	0.1	982@50 cycles	75%	11
porous Fe_2O_3 nanotubes	881	0.2	750@100 cycles	74%	12
	358	1			
Fe_2O_3 rod	700	0.15	415@30 cycles	70%	13
Mesoporous Fe_2O_3	900	0.1	900@100 cycles	75%	14
	450	1			
Fe_2O_3 /rGO	600	0.1C	300@100 cycles	70%	15
	250	5C			
Graphene wrapped Fe2O3	851	0.1 C	700 @ 50 cycles	79%	16
	295	5C			
Hollow and porous Fe_2O_3	953	0.1	933@100 cycles	71%	This work
	673	5			

Reference

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