

## Spherical graphite produced by waste semi-coke with enhanced properties as anode material for Li-ion batteries

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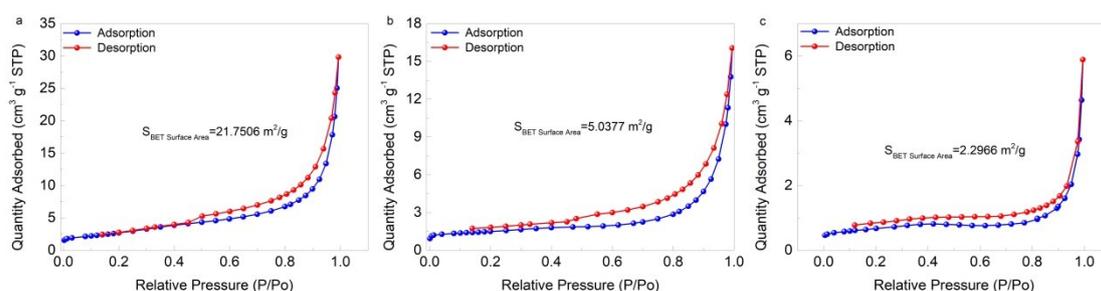


Fig. 1 N<sub>2</sub> absorption/desorption profiles of (a) pristine semi-coke (SC); (b) synthetic graphite without Si (PG); and (c) synthetic graphite with 10% Si at 2300 °C (SG).

**Table 1** The percentage of impurity of pristine SC and SG (10% Si at 2300 °C).

samples	Content percentage / wt %							
	B	Si	Al	Ca	Fe	K	Na	Mg
SC	<0.1	4.25	5.5	3.3	0.8	0.3	0.09	<0.1
SG	<0.1	1.01	1.9	0.1	<0.1	0.02	0.03	<0.1

**Table 2** The SG capacity values with that of similar materials published in the literature.

Materials	Specific Capacity [mA h g <sup>-1</sup> ]	Rate capability [mA h g <sup>-1</sup> ]	Cyclic retention	Ref.
Spherical graphite produced by waste semi-coke	347.06 at 0.05C	329.8 at 0.1C; 317.4 at 0.5 C and 262.3 at 1C	97.7% at 0.5C after 700 cycles	This work
Iron-catalyzed graphitic materials from biomass	306 at 0.1C	150 at rate of 2C	Over 90 % after 200 cycles	1
Carbonaceous composites prepared by the mixture of graphite, cokes, and petroleum pitch.	312 at 0.2C	149 at 1 C; 78 at 5C	-	2
An oxidation procedure to by-products of the petroleum industry	385 after 20 cycles at C/50	-	-	3
Needle coke refined by molten caustic leaching	560.137 at 0.9 mA	-	98.5% after 50 cycles	4
Surface-fluorinated petroleum cokes	306 at 60 mA g <sup>-1</sup>	-	98% after 10 <sup>th</sup> cycles	5
Anthracite	370 at 30 mA g <sup>-1</sup>	-	Nearly 100% after 20 cycles	6
Coating of graphite anode with coal tar pitch	361 at 0.1C	361 at 0.2C; 357 at 0.5C; 355 at 1C; 348 at 2C; 298 at 5C	83% at 5C	7
Porous carbon microspheres anode materials from fine needle coke powders	394 at 50 mA g <sup>-1</sup>	315 at 500 mA g <sup>-1</sup> ; 160 at 1000 mA g <sup>-1</sup>	range from 340 to 350 mA h g <sup>-1</sup> at 50 mA g <sup>-1</sup> after 100 cycles	8
Synthetic graphite from bituminous coal	310.3 at 0.1C	143.9 at 5C	Over 95.3% after 100 cycles	9
Synthetic graphite from semi-coke powders	351.5 at 0.1C	322 at 1C	97.6% after 300 cycles at 1C	10
Carbon nanofiber/graphite compounds	359 at 0.1C	299 at 1C	99.4% after 50 cycles at 0.1C and 90% after 300 cycles at 1C	11
Different series of coal ash treated at 2700 °C	-	-	310 mA h g <sup>-1</sup> after 50 cycles at 0.1C	12

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