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Ref. No.: CSG12/PS202112/01 **Last Update: 6 December 2021**

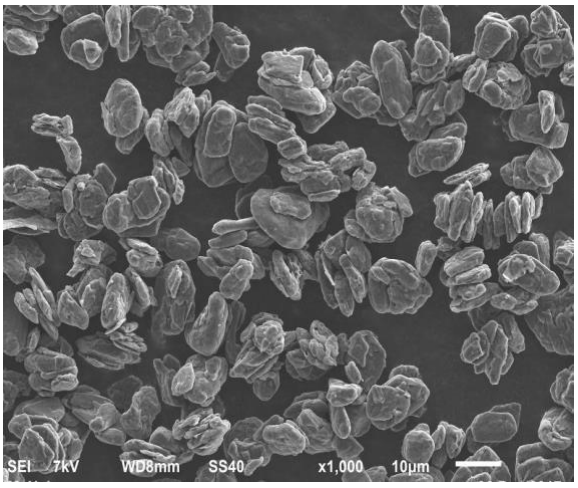
CSG-12 Product Specification

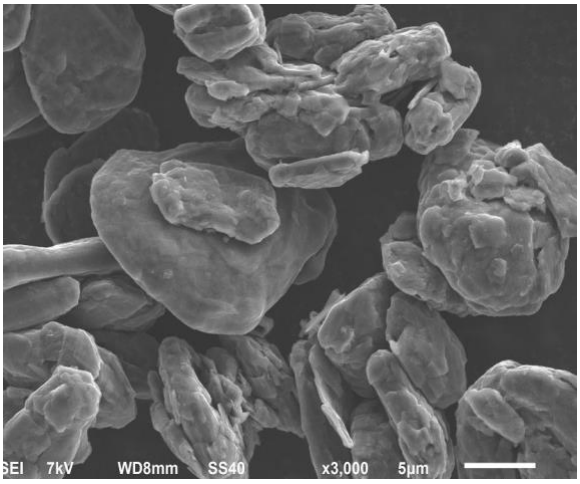
Applications: high-capacity and high rate capability cylindrical, square, pouch batteries.

1. Technical characteristics:
   CSG-12 is a pitch coated natural graphite product with small particle size (secondary granulation) which has the characteristics of high permeability, high rate capacity, small volume expansion, high and low temperature performance, and excellent processing performance.

2. Suitable for aqueous lithium-ion batteries with design specific capacity 355mAh/g, pellet density control1.65±0.5g/cm³. (For reference only)

Scanning Electron Microscope





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3. Technical data

Item	Unit		TypicalValue	Specification	Method/Instrument
Particle Size	D10	μm	7.239	8.0±2.0	Laser diffraction Malvern Mastersizer 3000
	D50	μm	12.304	12.5±1.5	
	D90	μm	20.936	21.5±4.5	
	Dmax	μm	48	≤70	
Tap Density	g/ml		1.13	1.10±0.10	Central Iron & Steel ResearchInstitute Model: FZS4-4B
Special Surface Area	m^2/g		1.69	≤2.5	Multi point BET (adsorption N2) Quantachrome Nova 4000E
Ash	%		0.1	≤0.10	Gravimetric method Sartorius Infrared Moisture Analyzer Model: MA-100
True Density	g/ml		2.20	≥2.10	True density analyzer Model: 3H-2000TD
Compacted Density	g/cm^3		1.65	1.65±0.5	Guangzhou Lange Electronics Model: CLG-ZM-400Y
Specific Capacity	mAh/g		363	≥360	Half-Cell Testing, using lithium metalas counter electrode Arbin multifunctional battery testingequipment Model: BT2000
Initial Coulombic Efficiency	%		92.5	≥90	

4. Formulation and procedures of anode material production: (For reference only)

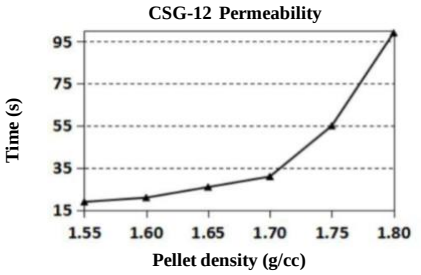
Proportion	CSG-12 : CMC : SBR : SP = 95.5 : 1.5 : 2.0 : 1
Thickener	SUNROSE MAC350HC
Bonding Agent	CB-100 (JSR)
Solid content	45%
Viscosity	3000 mpa.s
Mixing equipment	Blender (Hongyun)

Feeding order and procedures:

1. After being weighted on BOM basis, CMC be put into deionized water and mix for 2.0 hours (rotation/revolution speed: 30/25Hz).
2. Add Super-p and mix for 2.0 hours (rotation/revolution speed 30/25Hz).
3. Add CSG-12 and mix for 2.0 hours (rotation/revolution speed 20/25Hz).
4. Add SBR and mix for 1.5 hours (rotation/revolution speed 25/20Hz).
5. Measure the viscosity.
6. If the viscosity exceeds the standard limit, add deionized water at a moderate volume and mix for 0.5 hour to adjust the viscosity (rotation/revolution speed 15/20Hz)
7. Mix at a low speed for 30 minutes (rotation/revolution speed 5/10Hz).

5. Absorbent permeability test in different pellet density

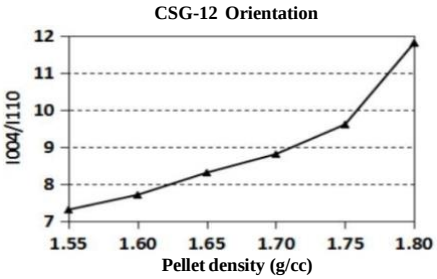
Measurement setup:
Absorbent:
LiPF6: 1mol/L,
EC : DEC : DMC = 1 : 1 : 1,
Volume: 1μL



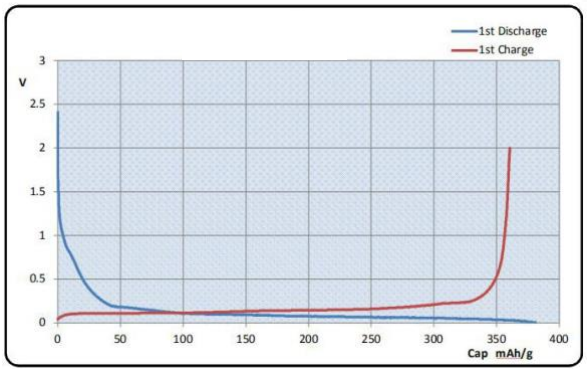
6. Test of orientation in graphite sheet electrode

Measurement setup：

1. Equipment: X-ray diffraction (XRD)
2. Graphite sheet electrode
3. Formulation:
   CSG-12 : CMC : SBR : SP = 94.5 : 2.0 : 2.5 : 1
   Coating: single side
   Cufoil: 12μm
4. Scan speed: 0.082
5. Scan step size: 0.0066
6. Scan angle: I004 (52~56 degree); I110 (75~79 degree)



7. Button battery charge and discharge scheme：
   1. Rest period : 24H
   2. 0.05C discharge, cutoff voltage 0.005V
   3. Rest period 10min
   4. 0.05C charge, cutoff voltage 2V

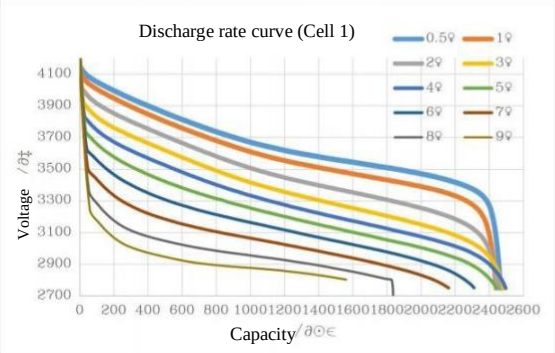


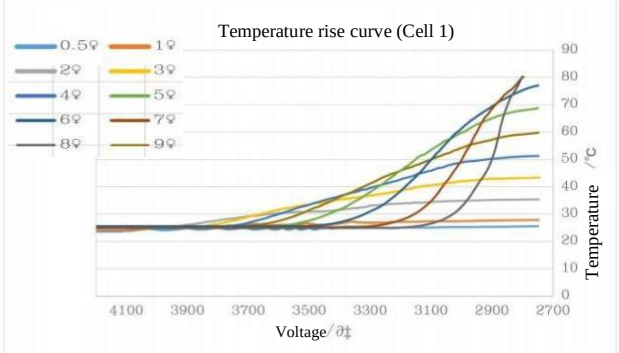
8. Cycling performance of finished battery
   Battery type: CR18650, 2500 mAh.
   Cathode: NCM 532
   Anode: CSG-12

   Electrochemical performance test data (extracted)

   1. Discharge rate performance

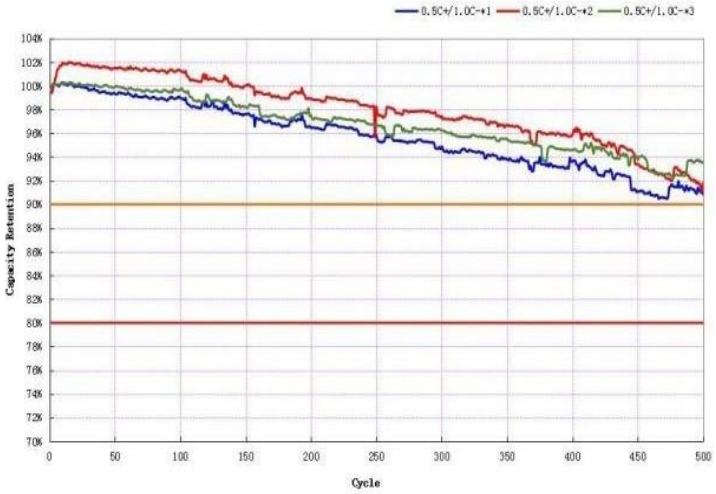
Rate Performance Test											
Cell No.	Discharge Capacity/ Retention rate @1C	Discharge rate (0.5C charge /different discharge rates)									
		0.5C	1C	2C	3C	4C	5C	6C	7C	8C	9C
1	Discharge capacity	2466.64	2440.68	2450.15	2482.33	2497.10	2445.43	2312.01	2163.16	1833.94	1561.75
	Retention rate	101.1%	100.0%	100.4%	101.7%	102.3%	100.2%	94.7%	88.6%	75.1%	64.0%
2	Discharge capacity	2478.83	2450.07	2492.05	2492.05	2508.72	2459.90	2340.23	2105.22	1799.73	
	Retention rate	101.2%	100.0%	101.7%	101.7%	102.4	100.4%	95.5%	85.9%	73.5%	





2. Cycling performance (1C – 3C)

Cathode	QY-901
Anode	CSG-12
Separator	60.5*14 μm
Electrolyte	JEC504
Rate Setting	1C/2C/3C



9. Environmental compliance of product

The product complies with EU RoHS Directive (Restriction of Hazardous Substances in Electrical and Electronic Equipment), the concentration of toxic and hazardous substances or elements contained in the product does not exceed the limit specified in SJ/T 11363-2006 “Limit Requirements for Toxic and HazardousSubstances in Electronic Information Products”.

10. Packaging and labeling

The product is packaged by a vacuum packaging machine, first put into an inner film bag, formed, heat-sealed,and then put into a carton with a net weight of 25.0 ±0.1kg/carton, or packed according to customer requirements.

The packaging label includes: product name, batch number, packaging specification, production date, factorydate, order number, inspection mark, RoHS mark, as well as company name, LOGO, and other customized information.

11. Storage and transportation

The product should be stored in a ventilated and dry warehouse and avoid mixing with materials that can deteriorate the product or damage the packaging bag during storage and transportation.

Unopened product has 1 year of durability period. Opened product should be used within one month and kept clean and dry.