山东重山光电材料股份有限公司

SHANDONG ZHONGSHAN PHOTOELECTRIC MATERIALS CO., LTD.

新能源电池及材料
NEW ENERGY BATTERY AND MATERIALS

特种功能氟碳材料
FUNCTIONAL FLUOROCARBON MATERIALS

半导体材料
SEMICONDUCTOR MATERIALS

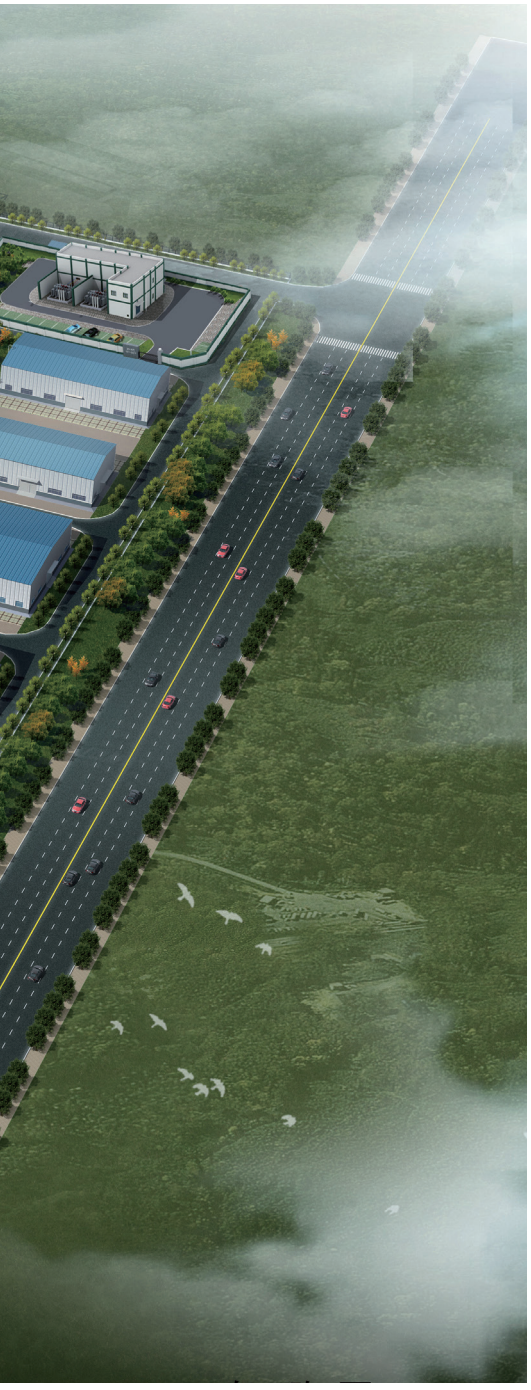
稳定同位素及其衍生材料
STABLE ISOTOPIC MATERIALS
AND DERIVATIVES

含氟生物医药材料
FLUORIDATED BIOMEDICAL MATERIALS

激光晶体材料
LASER CRYSTAL MATERIALS

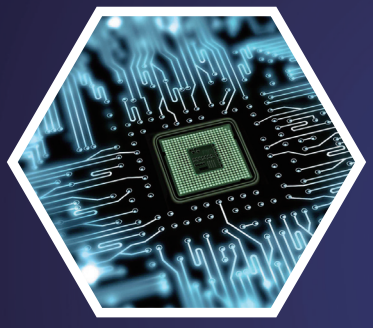
重山光电
ZSEM

公司介绍
Introduction



山东重山光电材料股份有限公司是一家集研发、中试、产业化为一体的高新技术企业。公司坐落于山东省淄博市淄川区南韩工业园内，注册资本金 3000 万元，总投资 12.7 亿元，项目占地 200 亩。2016 年，公司通过了 ISO9001:2015 质量体系认证；2018 年公司顺利通过了“国家高新技术企业”认定。同年，公司成为中国化学与物理电源行业协会锂电池分会理事单位，并获中国化学与物理电源行业协会锂电池分会特别贡献企业奖。2019 年，公司获批山东省首批化工重点监控点企业，为公司项目建设和可持续发展奠定坚实基础。

Shandong Zhongshan Photoelectric Materials Co., Ltd. is a high-tech enterprise invested and established by Shandong Zhongshan Group Co., Ltd., which integrates R&D, pilot test and industrialization. Our company is located in Zichuan district Nan Han industrial park, Zibo city, Shandong province. The registered capital of the company is 30 million RMB, the total investment is 1.27 billion RMB, the project base of our company covers an area of 200 mu. In 2016, the company passed the ISO9001:2015 quality system certification. In 2018, the company successfully passed the certification of "National High-tech Enterprise". In the same year, the company became the council member of Lithium Battery Branch of China Industrial Association of Power Sources, and won the special contribution enterprise award of Lithium Battery Branch of CIAPS. In 2019, the company was approved as one of the first batch of enterprises in special supervision points of chemical industry in shandong province, which is beneficial to the project construction and sustainable development of the company.



功能氟碳材料

公司业务
Business

公司主要业务为研发和生产功能氟碳材料（氟化石墨烯、氟化石墨等）；高比能量锂氟化碳电池及其关键材料（纳米氟化碳正极材料）；热电池及其关键材料（锂硼合金、锂硅合金）；锂电池用电解质（高纯晶体六氟磷酸锂、四氟硼酸锂、高氯酸锂及电解液添加剂等）；锂电池专用超薄金属锂带，三元复合材料，磷酸铁锂，硅碳负极材料；集成电路芯片与半导体器件制程用高纯电子特气、高纯电子化学品、高纯金属有机电子材料、氮化镓、半导体陶瓷材料等；超大规模集成电路芯片制程用硼 −11 系列材料；核电用硼 −10 中子吸收材料、硼 −10 系列防辐射材料及反应堆控制材料等稳定同位素材料；含氟生物医药材料。目标客户涵盖新能源电池、超大规模集成电路芯片、光电子及微电子器件、平板显示器、光伏电池、LED、光导纤维、核电安全、固体润滑、润滑油（脂）、防腐防污涂装、生物医药等行业。

The main business of the company is to research and produce functional fluorocarbon materials(fluorographene, fluorographite, etc.); high specific energy lithium fluorocarbon battery and its key materials(nano fluorocarbon cathode materials); thermal battery and its key materials(Li-B alloy, Li-Si alloy); electrolytes of lithium battery(lithium hexafluorophosphate, lithium tetrafluoroborate, lithium perchlorate and electrolyte additives); ultrathin lithium ribbon specially for lithium battery, ternary composites, lithium iron phosphate, silicon-carbon anode material ; IC chip and semiconductor device manufacturing process materials(high purity electronic specialty gases, high purity electronic chemicals, high purity metal organic electronic materials, silicon carbide, gallium nitride, semiconductor ceramic materials, etc.); stable isotope materials (B-11 materials in the super-large scale IC chip manufacturing; B-10 neutron absorber materials used in nuclear power, a series of B-10 radiation protection materials and nuclear reactor control materials); fluorine containing biomedical materials. Target customers include new energy battery, large scale IC chip, photoelectronic and microelectronic devices, flat panel display, photovoltaic cell, LED, optical fiber, nuclear power safety, solid lubrication, lubrication grease, anticorrosive and antifouling coating, biological medicine, etc.

研发团队
Research and development team

重山光电拥有以教授、研究员、博士后、博士、硕士、本科毕业生为主的 150 人研发团队，平均年龄 35 岁。经过数年的发展，公司取得了多项创新技术成果。最近 3 年申请专利超过 50 项，已获得授权发明专利 20 项。

Zhongshan Photoelectric Materials Co., Ltd. has a research and development team of 150 people with an average age of 35 years old, mainly including professors, researchers, postdocs, doctors, masters and undergraduates. The company has made a number of innovative technological achievements after several years of development. More than 50 patents have been applied, and 20 patents for invention have been authorized in recent 3 years.

研发条件
R & D condition

公司投入 5000 余万元建设了 5000m^2 研发中试平台。建有配套设施齐全、功能先进的高纯氟气、特种功能氟碳材料、半导体材料高纯电子特气 / 电子化学品、高比能量新能源电池、锂电池电解质及添加剂、热电池及相关材料、光电材料、稳定同位素及其衍生材料、含氟生物医药材料等项目小试、中试装置，可同时开展多个相关领域新材料及装备的创新研发试验和中试；建有全覆盖公司研发生产各项目产品所需的先进分析检测中心，测试仪器包括全套电池放电性能测试系统、电化学工作站、充放电仪器、锂电池试验专用手套箱、气相色谱仪、色质联用仪、ICP-MS、红外光谱仪、紫外分光光度计、金相显微镜、微量水分测量仪、粒度分析仪、全自动滴定仪、比表面积分析仪等。

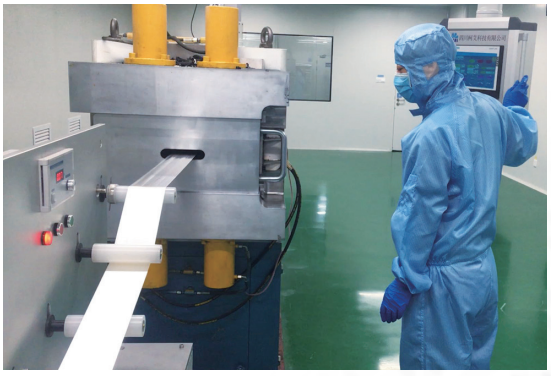
The company invested more than 50 million yuan to build a 5,000m^2 R&D pilot platform, including a number of complete supporting facilities and advanced function of test and pilot devices, such as high pure fluorine gas, special functional fluorinated carbon materials, semiconductor materials(high pure electronic gas/ electronic chemicals), high specific energy battery, lithium battery electrolytes and additives, thermal battery and related materials, photoelectric materials, stable isotope and its derivative materials, fluoridated biomedical materials, etc. The company can carry out a number of innovative research and development tests and pilot for related areas of new materials and equipments. The company has established an advanced analysis and testing center for R&D and production of all the projects. Testing instruments including a full set of battery discharge performance test system, electrochemical workstation, charging and discharging instruments, special glove box for lithium battery test, gas chromatograph, GC-MS, ICP-MS, infrared spectrometer, ultraviolet spectrophotometer, metallographic microscope, micro moisture meter, particle size analyzer, automatic titrator, specific surface area analyzer, etc.






公司建有全球首条氟化石墨烯规模化示范生产线及功能氟碳材料性能评价实验室，成为国内外首个能够大批量生产供应高品质氟化石墨烯的厂家。同时，利用氟化石墨烯示范装置可研发生产不同氟化程度、不同用途、不同前驱体结构的氟化石墨、氟化纳米石墨、氟化碳纳米管、氟化富勒烯、氟化石墨炔、氟化碳纤维、氟化活性炭、氟化碳黑、氟化金刚石、氟化焦炭、氟化沥青等系列功能氟碳材料，可进行材料相关性能评价。

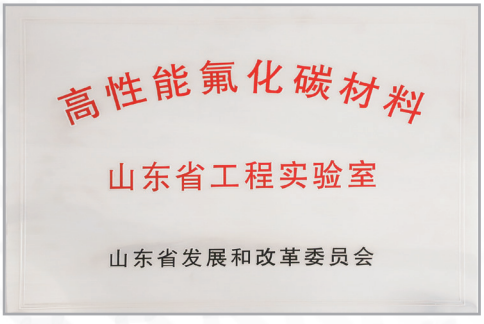
The company has built the first large-scale production line of fluorographene and functional fluorocarbon material performance evaluation laboratory all over the world, and has become the only manufacturer that can mass-produce and supply high-quality fluorographene at home and abroad up to now. At the same time, a series of functional fluorocarbon materials with different degrees of fluoride, different uses and different structures of precursor can also be produced with the same production equipment, such as fluorographite, fluorinated nano-graphite, fluorinated carbon nanotubes, fluorinated fullerene, fluorinated graphdiyne, fluorinated carbon fibers and fluorinated activated carbon, fluorinated carbon black, fluorinated diamonds, fluorocoke, fluoropitch, etc. The properties of those materials can also be evaluated.

研发条件
R & D condition

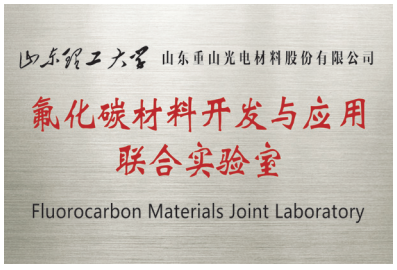
2017 年，公司氟化石墨烯项目被列为淄博市创新发展重点计划项目，热电池材料项目获批首批高端化工产业集群建设示范项目；2018 年，公司氟化碳项目被列为淄博市创新发展重点计划项目，功能氟碳材料被列入“山东省 2018–2022 年高端化工产业发展规划”，同时公司的功能氟碳材料研发平台被认定为淄博市工程实验室；2019 年，公司被认定为山东省“高性能氟碳材料工程实验室”，公司锂氟化碳电池项目被列为淄博市重点建设项目。

In 2017, the project of fluorographene was listed as the key project for innovative development of Zibo city, and the project of thermal battery materials was approved as the first batch of high-end chemical industry cluster construction demonstration projects. In 2018, the project of fluorocarbon was listed as the key project for innovative development of Zibo city, and functional fluorocarbon materials were listed in the "Development Plan of High-end Chemical Industry of Shandong province from 2018 to 2022". Meanwhile, the functional fluorocarbon materials research and development platform was identified as “Engineering Laboratory” of Zibo city. In 2019, the company was identified as "High-Performance Fluorocarbon Materials Engineering Laboratory" of Shandong province, and the project of lithium fluorocarbon battery was listed as a key construction project of Zibo city.



交流合作
Exchange and cooperation

公司秉持创新引领、安全环保、节能降耗、绿色发展、开放共享的发展理念，先后与天津力神特种电源科技股份公司、中科院兰州化学物理所、中科院宁波材料所、天津大学、电子科技大学、中国民航大学、山东理工大学、四川理工学院、天津大学山东研究院等建立了良好的合作关系。在天津大学山东研究院建有“重山光电信息与新能源材料研发实验室”，与山东理工大学联合建立了基于功能氟碳材料性能评价及应用基础研究的“氟化碳材料开发与应用联合实验室”，与中科院宁波材料技术与工程研究所合作共建了基于功能氟碳材料在润滑与防腐防污涂装领域工程化应用研发的“氟化碳材料联合应用技术工程中心”，与四川轻化工大学合作共建了基于耐蚀新材料和电解槽腐蚀控制技术应用研发的“耐蚀新材料与腐蚀控制技术研发中心”，助推功能氟碳材料的基础研究和工程化应用开发。



Our company adheres to the development philosophy of innovation, safety and environmental protection, energy saving, green development, opening and sharing, and has established the favorable cooperative relationship with Tianjin Lishen special power technology co. Ltd, Lanzhou Institute of Chemical Physics, Ningbo Institute of Materials Technology & Engineering, CAS, Tianjin University, University of Electronic and Technology of China, Civil Aviation University of China, Shandong University of Technology, Sichuan University of Science & Engneering, Shandong Research Institute of Tianjin University. "Zhongshan Photoelectric Information and New Energy Materials Research and Development Laboratory" has been established in Shandong Research Institute of Tianjin University, " United Laboratory for Development and Application of Fluorocarbon Materials " has been established with Shandong University of Technology based on the performance evaluation and basic applied research of the functional fluorocarbon materials, "United Applied Technology and Engineering Center of Fluorocarbon Materials" has been established in cooperation with Ningbo Institute of Materials Technology & Engineering, CAS, which is based on engineering research and development of functional fluorocarbon materials in the field of lubrication, anticorrosion and antifouling coating."R&D Center of Novel Corrosion Resistant Materials and Corrosion Control Technology" has been established in cooperation with Sichuan University of Science & Engineering, which is based on engineering research and development of novel corrosion resistant materials and corrosion control technology of electrolytic tank.

远景目标
Long-term goal

重山光电远景目标是将公司打造成为国内外具有鲜明产业特色的先进光电信息与新能源材料研发、中试、生产、物流基地。

Long-term goal of Zhongshan Photoelectric Materials Co., Ltd. is to build the company into an advanced photoelectric information and new energy materials base which includes R & D, pilot test, production and logistics, and the base should have distinctive industrial characteristics at home and abroad.

锂氟化碳电池

Lithium-Fluorocarbon Battery

锂氟化碳电池(Li−$(CF_x)_n$),正极为氟化碳材料$(CF_x)_n$,负极为金属锂,基于最优氧化还原体系 – 氟和锂的一次电池,是目前性能最佳的一次电池体系。锂氟化碳电池体系的理论能量密度高达 2180Wh/kg,是一次电池中理论比能量最大的电池体系。锂氟化碳电池包含扣式、圆柱形和软包电池。

Lithium-fluorocarbon battery (Li-$(CF_x)_n$) with cathode material of $(CF_x)_n$ and anode material of lithium, which is the best primary battery system at present. The theoretical energy density of the Li-$(CF_x)_n$ battery system is up to 2180Wh/kg, which is the battery system with the largest theoretical specific energy in the primary batteries. Lithium-fluorocarbon batteries consist of button, cylindrical and soft package batteries.

1

卓越的应用性能 Excellent performance of application

氟化碳电池比容量大,能量密度高,很容易做到小型化和轻型化。

With high specific capacity and high energy density, fluorocarbon batteries are easy to be miniaturized.

3

优异的放电性能 Excellent discharge performance

工作电压可达 3V 以上,同时由于电池在工作时,氟化碳转化成氟化锂和能导电的碳,利用率几乎为100%,放电平台平稳,工作电压可以稳定到放电结束。

The discharge performance of Li-$(CF_x)_n$ battery is excellent, the working voltage is as high as 3V. At the same time, when the battery is working, the fluorocarbon is converted into lithium fluoride and carbon that can conduct electricity, and the internal resistance does not increase. The discharge plateau is stable, and the working voltage can be stable until the end of discharging.

5

优越的安全性能 Superior safety performance

电池具有优异的化学稳定性和物理稳定性,经实验证明,在短路、挤压、碰撞、过放、高温等误用情况下仍有很高的安全性。

The excellent chemical and physical stability of the fluorocarbon ensures the safety of the Li-$(CF_x)_n$ battery. It is still very safe in the case of short circuit, extrusion, collision, over discharge and high temperature.

2

超强的耐高温性能 Excellent high temperature resistance

氟化碳材料本身具有较好的热稳定性,高温(≤600℃)不会分解,低温不会结晶,因而锂氟化碳电池高温下容量保持率好,经改进后的电池可达到 −40 ~ +125℃的工作范围。

Fluorocarbon material has excellent thermal stability and does not decompose at high temperature(≤600℃), besides it does not crystallize at low temperature, so the capacity retention rate of Li-$(CF_x)_n$ battery is high, the working temperature range of Li-$(CF_x)_n$ battery can achieve to -40 ~ +125 ℃ after the battery is improved.

4

良好的贮存性能 Good storage performance

氟化碳电池无论是在使用过程中还是在正常储存下,其自放电率很低,小于 1%,保存寿命可达 10 年以上。

Li-$(CF_x)_n$ battery is very stable, no matter in the process of using or in the condition of normal storage, its self-discharge rate is lower than 1%, its shelf life is more than 10 years.

6

绿色环保 Green environmental protection

电池的生产、使用和报废过程中,不涉及任何重金属。

During the process of production,using and rejection of batteries, there is no heavy metals involved.

纽扣电池
Button Battery

产品综述
Product summary

锂氟化碳纽扣电池产品主要包括 BR2016、BR2025 和 BR2032 等型号，具有体积小、贮存寿命长、使用安全和工作温度范围宽的特点，在 −40 ~ +80℃下电池均能正常工作。通常应用于对电源要求具有高低温性能和高能量密度的应用领域，如汽车胎压计（TPMS）、汽车钥匙、工业控制主板、电脑主板、智能仪表、无人值守仪表、植入式医疗等应用领域。

Lithium-fluorocarbon button battery products mainly include models of BR2016, BR2025 and BR2032, etc., it has the characteristics of small volume, long storage life, safety, wide working temperature range, and it can work normally under -40~+80℃. Generally, the battery is used in the situations for power requirements with high and low temperature performance, high energy density, such as tire pressure monitor system(TPMS), car keys, industrial control board, computer motherboard, intelligent instrument, unattended operation instrument and other applications.

锂氟化碳纽扣电池参数
Parameters of lithium-fluorocarbon button battery

型号 Type	标称电压(V) Nominal voltage	标称电流（mA） Nominal current	标称容量（mAh） Nominal capacity	最大连续电流（mA） Maximum continuous current	最大尺寸（mm） Maximum size	工作温度（℃） Working temperature	重量（g） Weight
BR1025	3	0. 1	50	2	φ10. 0×2. 5	−40～+80	0. 6
BR1225	3	0. 1	60	2	φ12. 0×2. 5	−40～+80	0. 8
BR1616	3	0. 1	100	2	φ16. 0×1. 6	−40～+80	1. 0
BR1632	3	0. 1	150	2	φ16. 0×3. 2	−40～+80	1. 7
BR2016	3	0. 2	120	2	φ20. 0×1. 6	−40～+80	1. 6
BR2025	3	0. 2	160	2	φ20. 0×2. 5	−40～+80	2. 4
BR2032	3	0. 2	220	2	φ20. 0×3. 2	−40～+80	2. 9
BR2325	3	0. 2	180	2	φ23. 0×2. 5	−40～+80	3. 2
BR2335	3	0. 2	320	2	φ23. 0×3. 5	−40～+80	4. 3
BR2354	3	0. 2	440	2	φ23. 0×5. 4	−40～+80	6. 2
BR2440	3	0. 3	400	2	φ24. 0×4. 0	−40～+80	5. 0
BR2450	3	0. 3	570	2	φ24. 0×5. 0	−40～+80	6. 0
BR3032	3	0. 3	520	2	φ30. 0×3. 2	−40～+80	5. 5

应用：后备电源：汽车胎压计、车钥匙、电子表、遥控器等
Applications: Back−up source: tire pressure gaugecar key, electronic meter,camera,remote control,etc.

备注：在 25℃条件下，输出终止电压为 2V
Remark： At 25℃，2V recommend cut−off.

圆柱电池
Cylindrical Battery

产品综述
Product summary

圆柱电池主要包括 18650、18500、10440、14500 和 32590 等型号，具有容量高、使用环境温度宽广等优点，产品可应用于遥控器、相机、照明灯具、玩具产品、电动工具、便携式能源和应急设备等领域。

The cylindrical battery mainly includes models of 18650, 18500, 10440, 14500 and 32590, etc., which have the advantages of high capacity and wide operating temperature, the products can be used in remote control, camera, lighting, toy products, power tools, portable power sources and emergency equipment and other applications.

锂氟化碳圆柱电池参数
Parameters of lithium-fluorocarbon cylindrical battery

型号 Type	标称电压（V）Nominal voltage	标称电流（mA）Nominal current	标称容量（mAh）Nominal capacity	最大连续电流（mA）Maximum continuous current	最大尺寸（mm）Maximum size	工作温度（℃）Working temperature	重量（g）Weight
BR14250	3	10	1200	500	φ14.5×25.5	−40～+80	7
BR14500	3	10	2500	1000	φ14.5×50.5	−40～+80	15
BR17490	3	10	3500	1000	φ17.5×49.5	−40～+80	20
BR18500	3	20	4000	2000	φ18.5×50.5	−40～+80	23
BR18650	3	20	5000	2000	φ18.5×65.5	−40～+80	28
BR21700	3	30	6500	3000	φ21.5×70.5	−40～+80	38
BR26500	3	30	7500	3000	φ26.5×50.5	−40～+80	44
BR32590	3	100	12000	4000	φ32.5×59.5	−40～+80	68
应用：移动电源、手电筒、应急设备、报警装置、遥控器等 Applications: Portable power, electric torch, survival and emergency equipment, alarming device, remote control, etc.							
备注：在 25℃条件下，输出终止电压为 2V Remark:At 25℃，2V recommend cut-off.							

软包电池
Soft Package Battery

产品综述
Product summary

软包电池是一种采用铝塑膜作为外包装的电池，具有安全性能好、重量轻、容量大、内阻小和设计灵活（电芯型号可定制）等优点。软包电池特别适合对电源要求具有高低温性能、高能量密度和高放电平台的应用领域，如航空航天、无人载具、无人值守设备、野外作业、手持电台、各种电子产品备用电源等电子电源产品领域。

Soft package battery is a kind of battery using aluminum-plastic film as the outer package, it has advantages of wonderful safety performance, light weight, high capacity, low internal resistance and flexible design (battery models can be customized). Soft package battery is especially suitable for application fields for power requirements with high and low temperature performance, high energy density and high discharge platform, such as aerospace, unmanned vehicles, unattended operation equipment, field work, handheld radio, medical devices, backup power of various electronic products and other applications.

锂氟化碳软包电池参数
Parameters of lithium-fluorocarbon soft package battery

型号 Type	标称电压（V）Nominal voltage	标称电流（mA）Nominal current	标称容量（Ah）Nominal capacity	最大连续电流（A）Maximum continuous current	最大尺寸（mm）Maximum size	工作温度（℃）Working temperature	重量（g）Weight
BF224558	3	10	3	1	2.2×58×45	-40～+80	11
BF673863	3	20	5	2	6.7×38×63	-40～+80	18
BF773856	3	30	6	3	7.7×38×56	-40～+80	21.5
BF825287	3	100	12	6	8.2×52×87	-40～+80	43
BF1154868	3	100	13	6	11.5×48×68	-40～+80	46
BF1256081	3	150	21	10	12.5×60×81	-40～+80	75
应用：移动电源、无人机、应急设备、报警装置、遥控器等 Applications:Portable power,unmanned plane,survival and emergency equipment, alarming device, remote control, etc.							
备注：在25℃条件下，输出终止电压为2V Remark:At 25℃，2V recommend cut-off.							

功能氟碳材料

Functional Fluorocarbon Materials

氟碳材料是一种性能特殊的功能型碳基氟材料。氟碳材料产品具有极低的表面能、优异的化学和热稳定性以及超高理论比容量，可用于固体润滑、特殊防腐防污涂料、特殊阻火材料、核反应堆减速剂和锂氟化碳电池等领域。

2016 年建成规模化示范生产线，并成功生产出不同的氟化碳材料，包括氟化石墨、氟化石墨烯（粉末、片等）、衬底氟化石墨烯、氟化碳纳米管、氟化碳黑、氟化金刚石、氟化碳纤维、氟化焦炭、氟化沥青及氟化石墨烯－聚苯胺复合材料等。本公司可以根据客户要求提供微氟化、中度氟化和全氟化等定制类氟化产品。

As a kind of functional carbon material, fluorocarbon materials have many specialty performances. They have been widely used in solid lubrication, corrosion protective and antifouling coating, flame retardant material, moderator of nuclear reactor and Li-CF_x batteries due to the merits of extremely low surface energy, excellent chemical stability, outstanding heat endurance and super theoretical specific capacity.

The large scale demonstration production line has been completed in 2016, many productions have been produced, including fluorographite, fluorographene (powder, flake and etc.), fluorographene substrate, fluorinated carbon nanotubes, fluorinated carbon black, fluorodiamond, fluorinated carbon fiber, fluorocoke, fluoropitch and fluorographene/PANI composite, etc. And we can customize various fluorinated products of different fluorination ratios for customers.


氟化石墨烯
Fluorographene
氟化石墨
Fluorographite
氟化金刚石
Fluorinated diamond
氟化碳纳米管
Fluorinated Carbon Nanotubes
氟化碳纤维
Fluorinated Carbon Fiber
氟化碳黑
Fluorinated Carbon Black
氟化焦炭
Fluorocoke
氟化活性炭
Fluorinated Activated Carbon
氟化石墨炔
Fluorinated graphdiyne
氟化沥青
Fluoropitch
氟化富勒烯
Fluorinated fullerene
氟化石墨烯聚苯胺复合材料
Fluorographene PANI Composites

氟化石墨
Fluorographite

产品综述
Product summary

氟化石墨是氟原子插入石墨层间的一种石墨层间化合物，粉末状固体，颜色随氟碳比的提高逐渐由黑变为灰白，直至白色。氟化石墨具有极低的表面能、优异的化学和热稳定性、极好的润滑性能以及超高理论比容量，使其在固态润滑、防腐防污涂料、锂电池和其它应用领域具有良好的应用前景。氟化石墨根据采用原料不同可细分为氟化鳞片石墨、氟化球形石墨、氟化膨胀石墨及氟化纳米石墨等种类。

Fluorographite is a kind of graphite interlayer compound in which fluorine atoms are inserted into graphite layers. Fluorographite is a powder solid, and its color gradually changes from black to gray to white with the increasing of F/C ratio. Fluorographite has been widely used in solid lubrication, corrosion protective and antifouling coatings,Li-CF_x batteries and other fields due to the merits of extremely low surface energy, excellent chemical and thermal stability, outstanding lubrication performance and super theoretical specific capacity. Fluorographite can be subdivided into fluorinated flake graphite, fluorinated spherical graphite, fluorinated expanded graphite and fluorinated nano-graphite according to different raw materials.

氟化石墨（能量型）
Fluorographite (energy-type)

氟化石墨（功率型）
Fluorographite (power-type)

氟化石墨（倍率型）
Fluorographite (high discharge rate-type)

产品名 Product name	纯度 Purity	氟含量 Fcontent	粒径（D50） Particle size	振实密度 Tap density
氟化石墨 Fluorographite	≥ 99%	45-65 wt.%	≤ 20 μm	≥ 0.9g/cm^3

电化学性能
Electrochemistry performance

1

氟化石墨作为正极材料应用于锂氟化碳电池，在 C/10 的放电倍率下，可适用于能量型、功率型和倍率型一次电池。

Fluorographite is used as cathode material of lithium-fluorocarbon batteries, at the discharge rate of C/10, it can be applied in energy-type, power-type and high discharge rate-type primary batteries.

2

能量型氟化石墨放电平台≥ 2.5V，比容量＞ 800mAh/g，比能量高达 2000Wh/kg 以上，是一种性能优秀的锂一次电池正极材料。

The discharge platform of energy-type fluorographite is equal or greater than 2.5V, the specific capacity of energy-type fluorographite is more than 800mAh/g and its specific energy is more than 2000Wh/kg, which is a kind of cathode material with excellent performance in lithium primary battery.

3

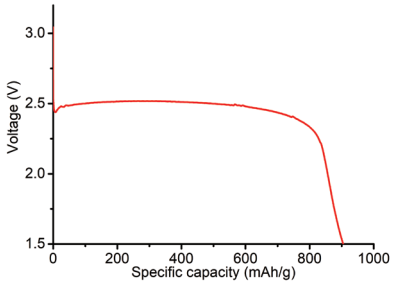
功率型氟化石墨放电平台≥ 2.8 V，比容量＞ 700 mAh/g，比能量高达 1900Wh/kg 以上，综合性能极佳，在不同的温度和放电电流下均有良好的性能表现，适用于需要更高放电电压和功率密度的场合。

The discharge platform of power-type fluorographite is equal or greater than 2.8V, the specific capacity of power-type fluorographite is more than 700mAh/g and its specific energy is more than 1900Wh/kg. The combination properties of power-type fluorographite are excellent, which exhibits prominent performance at different temperature and discharge current, it is suitable for the situation requiring higher discharge voltage and higher power density.

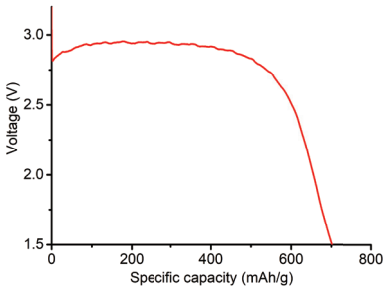
4

倍率型氟化石墨由能量型氟化碳材料改性而来，大幅提升了导电性，可实现高倍率放电。在 5C 倍率下放电平台≥ 2V，相比 0.1C 比容量保持率≥ 70%，适用于对放电电压无特殊要求，但需要大电流放电的场合。

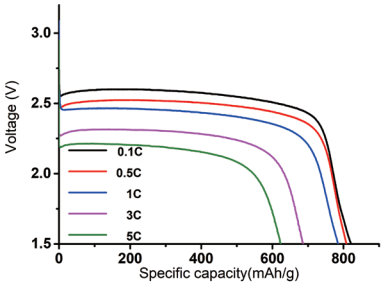
The high discharge rate-type fluorographite is modified by the energy-type fluorographite, the modification greatly improves the conductivity, as a result it can discharge at the high rate. The discharge platform of high discharge rate-type fluorographite is equal or greater than 2V at the discharge rate of 5C, comparing with 0.1C rate the capacity retention ratio is equal or greater than 70%. It is suitable for the occasions without special requirement for discharge voltage but requiring high current discharge.



氟化石墨（能量型）
Fluorographite (energy-type)



氟化石墨（功率型）
Fluorographite (power-type)



氟化石墨（倍率型）
Fluorographite (high discharge rate-type)

- 放电曲线 Discharge curves

氟化石墨烯
Fluorographene

产品综述
Product summary

氟化石墨烯是一种重要的新型石墨烯衍生物。氟化石墨烯与石墨烯相比，虽然碳原子的杂化方式由 sp^2 转变为 sp^3，但同时也保留了石墨烯的片层结构。因此，氟化石墨烯不但具有石墨烯一般大的比表面积，同时由于氟原子的引入极大地降低了石墨烯表面能，极大地增强了疏水疏油性，提高了热稳定性、化学稳定性及抗腐蚀能力。氟化石墨烯的这些独特性能使其可广泛应用于抗磨润滑、耐高温腐蚀涂层等，同时由于氟化石墨烯的较长带隙宽使其在纳米电子器件、光电子器件以及热电装置等领域具有潜在的应用前景。此外，由于氟化石墨烯基氟碳材料具有发达的比表面和孔结构，且氟含量的不同对能带结构具有可调节性，导致其具有独特的导电性能，用于锂一次电池正极材料时具有与电解液接触界面大、锂离子扩散速度快等特点，用氟化石墨烯做正极材料的锂原电池具有能量密度高、放电平台高且平稳、使用温度范围宽、存储寿命极长等优点，在航空航天和高端民用领域有极大的应用潜力。

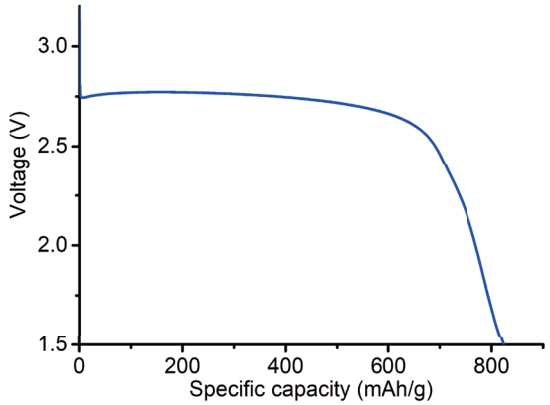
Fluorographene is an important graphene derivative. Compared with graphene, fluorographene retained the lamellar structure of graphene although the carbon atoms were hybridized from sp^2 to sp^3. As a result, fluorographene has not only large specific surface area, at the same time due to the introduction of fluorine atoms, the surface energy of graphene was greatly reduced, the property for hydrophobic and oleophobic was greatly enhanced, while the thermal stability, chemical stability and corrosion resistance were largely improved. Due to its unique properties, fluorographene can be widely used in the fields of anti-wear lubrication, high temperature corrosion resistant coating, at the same time, due to its wider bandgap, fluorographene has potential applications prospect in nano-electronic devices, photoelectronic devices, thermoelectric devices and other fields. In addition, because the fluorocarbon materials have fairly developed specific surface and pore structure and unique conductivity, the lithium primary batteries will have large contact interface with electrolyte and fast lithium ion diffusion speed, when fluorographene used as cathode material of lithium batteries. These lithium primary batteries have the advantages of high energy density, high discharge voltage, stable discharge curve, wide operating temperature, extremely long shelf life, which has great application potential in the aerospace and high-end civil field.

产品名 Product name	纯度 Purity	氟含量 Fcontent	粒径（D50） Particle size	层数 Layers	振实密度 Tap density
氟化石墨烯 Fluorographene	≥ 99%	45-65 wt.%	≤ 20 μm	≤ 15	≥ 0.2g/cm^3

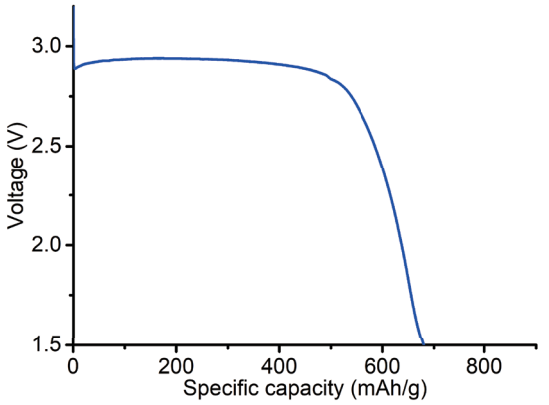
电化学性能
Electrochemistry performance

氟化石墨烯作为正极材料应用于锂氟化碳电池，在 C/10 的放电倍率下，可适用于能量型（放电平台≥ 2.6V，比容量＞ 800mAh/g）和功率型（放电平台≥ 2.85V，比容量＞ 750mAh/g）一次电池。

Fluorographene is used as cathode material of lithium-fluorocarbon batteries, at the discharge rate of C/10, it can be applied in energy-type and power-type primary batteries.The discharge platform of energy-type fluorographene is equal or greater than 2.6V, the specific capacity is more than 800mAh/g, while the discharge platform of power-type fluorographene is equal or greater than 2.85V, the specific capacity is more than 750mAh/g.



氟化石墨烯（能量型）
Fluorographene (energy-type)



氟化石墨烯（功率型）
Fluorographene (power-type)

- 放电曲线 Discharge curves

氟化碳纳米管
Fluorinated Carbon Nanotubes

产品综述
Product summary

氟化碳纳米管（FCNTs）外观为粉末状固体，颜色随氟碳比提高逐渐由黑变为灰白，直至呈现白色。碳纳米管（CNTs）自上世纪 90 年代被发现后，受到了人们的广泛关注。但是由于 CNTs 表面的相对惰性，且容易团聚缠绕，很难在介质中分散，限制了其应用，因此对 CNTs 进行表面修饰成为了 CNTs 研究领域的热点。FCNTs 一方面保持了其原本的三维管状结构，另一方面显著改变了其表面特性、导电性、润滑性等性质，使其可以通过亲核取代进行进一步的表面修饰，这些特点使 FCNTs 在锂电池正极材料、固态润滑、复合物填充剂等领域具有独特的用途。采用不同直径和种类的碳纳米管，可以合成具有不同直径的单壁、少壁及多壁的氟化碳纳米管。

Fluorinated carbon nanotubes (FCNTs) are powder solid, and their color gradually changes from black to gray to white with the increasing of F/C ratio. Carbon nanotubes (CNTs) have received a lot of attentions since they were discovered in the 1990s. However, due to the relative inertia of the CNTs surface and the fact that they are easy to agglomerate and difficult to disperse, which limits their applications. Therefore, the surface modification of carbon nanotubes has become a hot research topic in the field of CNTs. On the one hand, FCNTs maintain their original three-dimensional tubular structure; on the other hand, their surface properties are significantly changed, such as conductivity and lubricity, so that surface properties can be further modified by nucleophilic substitution. These characteristics make FCNTs have a unique use in the field of lithium primary battery cathode materials, solid lubrication, composite filling agent and so on. FCNTs are prepared from different diameters and types of carbon nanotubes by fluorination, including single, few and multi-walled FCNTs with different diameters.

氟化碳黑
Fluorinated Carbon Black

产品综述
Product summary

氟化碳黑是一种基于碳黑制备的新型氟化碳材料，粉末状固体，颜色随氟碳比的提高逐渐由黑变白。除了具有与氟化石墨相似的表面性质，氟化碳黑还具有密度低、粒径小的特点。因此在润滑油添加剂、高温润滑材料、脱模剂、防水防油材料以及防腐涂料等方面具有潜在的应用价值。

Fluorinated carbon black is a new type of fluorocarbon material based on carbon black. Fluorinated carbon black is powder solid, and their color gradually changes from black to gray to white with the increasing of F/C ratio. In addition to the surface properties similar to those of fluorographite, fluorinated carbon black also has the characteristics of low density and small particle size. Therefore, it has potential application value in lubricating oil additives, high temperature lubricating materials, mold release agents, water-proof and oil-proof materials and anticorrosive coatings.

氟化碳纤维
Fluorinated Carbon Fiber

产品综述
Product summary

氟化碳纤维由于表面能偏低，化学惰性强等特点，其应用领域受到了一定的限制。较低程度的表面氟化改性可以提高碳纤维的表面能，使其浸润性和粘结性大大提高，而较高程度的表面氟化反而能够进一步降低其表面能，增强其润滑性和在溶液中的分散性，从而大大拓展其应用领域。氟化碳纤维可以用作绝缘体、电池活性物质、轻质高导电性物质。

Due to the characteristics of low surface energy and strong chemical inertness, the application of fluorinated carbon fiber is limited. Low degree of surface fluorination can improve the surface energy of carbon fiber and greatly improve its wettability and adhesion, while high degree of surface fluorination can further reduce its surface energy and enhance its lubricity and dispersion in solution, thus greatly expanding other application fields. Fluorinated carbon fiber can be used as insulator, active materials for battery, light and high conductivity materials.

氟化沥青
Fluoropitch

产品综述
Product summary

氟化沥青是一种性质优越的材料，其性质类似于氟化石墨和聚四氟乙烯，但它的表面能 (2.0 mJ/m^2) 比氟化石墨 (7.0 mJ/m^2) 和聚四氟乙烯 (15.88 mJ/m^2) 低很多，与水的接触角最高达 145° 。氟化沥青在疏水涂料、防水、润滑、电池等方面均具有良好的应用前景，可以用作防污涂料、防水材料、脱模剂、粘结剂、清洁剂、电子元件探测剂、焊接保护、高真空油、电子绝缘油、非可燃润滑剂和电极材料。

Fluoropitch is a kind of advantageous properties material, its properties are similar to fluorographite and PTFE, but its surface energy (2.0 mJ/m^2) is much lower than that of fluorographite (7.0 mJ/m^2) and PTFE (15.88 mJ/m^2), and the water contact angle of fluoropitch is up to 145 °. It has good application prospect in hydrophobic coatings, waterproof, lubrication, battery fields. Fluoropitch can be used as antifouling coatings, waterproof materials, release agents, binder, cleaner, electronic component detector, welding protection, high vacuum oil, electronic insulating oil, non-combustible lubricant and electrode materials.

氟化焦炭
Fluorocoke

产品综述
Product summary

氟化焦炭采用焦炭为原料制成。相比其他原料，焦炭成本低廉，孔结构发达，而且氟化后也具有表面能低、化学稳定性和热稳定性强等特点，因此同样可以应用在抗油防水涂料、脱模剂等领域。

Fluorocoke is made from coke. Compared with other raw materials, coke has the advantages of low cost and developed pore structure, and the fluorinated coke also has the characteristics of low surface energy, chemical stability and thermal stability, etc., so fluorocoke can also be used in oil resistant and waterproof coatings, mold release agents and other fields.

氟化活性炭
Fluorinated Activated Carbon

产品综述
Product summary

氟化活性炭是以活性炭为碳源合成的一种特殊氟化碳材料，具有与氟化石墨相似的低表面能、较好的化学稳定性和热稳定性，并且保留了活性炭发达的孔结构。氟化活性炭用于锂氟化碳电池正极材料，初始放电电压可高达 3V，比容量可达 600mAh/g 以上。

Fluorinated activated carbon is a special fluorinated carbon material synthesized from activated carbon, which has the same low surface energy, good chemical stability and thermal stability as fluorographite, and retains the well-developed pore structure of activated carbon. Fluorinated activated carbon is used as the cathode material of lithium fluorocarbon battery, the initial discharge voltage can be up to 3V and the specific capacity can be more than 600mAh/g.

氟化石墨烯 / 聚苯胺复合材料
Fluorographene/PANI Composites

产品综述
Product summary

氟化石墨烯 / 聚苯胺复合材料，是采用苯胺单体与氟化石墨烯混合均匀后通过原位聚合的方法所制备的。聚苯胺均匀掺杂在氟化石墨材料中，改善了氟化石墨烯的导电性，并提高了氟化石墨烯在动力电池方面的性能。随着导电材料的加入，大大拓宽氟化碳材料的应用领域。

Fluorographene/PANI composites are synthesized by in-situ polymerization with aniline monomer and fluorographene. The introducing of PANI in fluorographene improved its conductivity, and enhanced its performance in power batteries. With the addition of conductive materials, the application fields of fluorocarbon materials are greatly broadened.

锂 带
Lithium Ribbon

产品综述
Product summary

锂 (Li) 是一种银白色金属，质软，是密度最小的金属。锂的相对原子质量为 6.94，密度为 0.534g/cm^3 ，熔点为 180℃，可与大量无机试剂和有机试剂发生反应，性质极不稳定，遇空气易变质，可与水发生剧烈的反应。因锂的原子量很小，用锂作为阳极的电池具有很高的能量密度。此外，锂电池还具有质量轻、体积小、寿命长、性能好等优点，电池领域已成为锂的最大应用领域。

Lithium (Li) is a kind of silvery white metal, soft, with the minimum density of all metals. Relative atomic mass of lithium is 6.94, with the density of 0.534 g/cm^3 , melting point of 180℃ . Li can react with a large number of inorganic reagents and organic reagents, its chemical property is instable and decomposed easily, react violently with water. Due to the small atomic mass, the battery used lithium as the anode materials has a high energy density. In addition, lithium battery has the advantages of light weight, small size, long lifetime, good performance and so on. The battery field has become the largest application field of lithium.

产品综述
Product summary

牌号 Category	Li，（≥wt.%）	杂质含量 Impurity Content (wt.%)											
		K	Na	Ca	Fe	Si	Al	Ni	Cu	Mg	Cl	N	Pb
Li-2	99. 95	0. 001	0. 010	0. 010	0. 002	0. 004	0. 005	0. 003	0. 001	0. 005	0. 005	0. 010	0. 0010
Li-3	99. 90	0. 005	0. 020	0. 020	0. 005	0. 008	0. 005	0. 003	0. 004	0. 010	0. 006	0. 020	0. 0030
Li-4	99. 00	–	0. 200	0. 040	0. 010	0. 040	0. 020	–	0. 010	–	–	–	0. 0050

备注：1、锂含量（质量分数）为 100% 减去表中杂质实测总和后的余量。
2、需方如对锂带的化学成分有特殊要求时，由供需双方商定。

Remarks :1.The lithium content (mass fraction) is 100 % minus the total amount of impurities measured in the table.
2. Special requirements for the chemical composition of lithium ribbon should be agreed by seller and buyer.

尺寸规格
Dimensions

牌号 Category	规格 Specification		厚度及公差 Thickness and tolerances		宽度及公差 Width and tolerances	
	厚度（mm） Thickness	宽度（mm） Width	厚度（mm） Thickness	公差（mm） Tolerance	宽度（mm） Width	公差（mm） Tolerance
Li-2 Li-3 Li-4	0. 1 ～ 4. 0	4. 0 ～ 120	0. 10 ～ 0. 20	±0. 01	4. 0 ～ 40	±0. 2
			＞ 0. 20 ～ 0. 60	±0. 02	＞ 40 ～ 100	±0. 3
			＞ 0. 60 ～ 0. 80	±0. 03		
			＞ 0. 80 ～ 1. 00	±0. 04	＞ 100 ～ 120	±0. 4
			＞ 1. 00 ～ 4. 00	±0. 05		
备注：产品尺寸规格可根据用户要求定制更改。 Remark:The dimension of products can be customized according to customers' requirements.						

表面质量
Surface quality

锂带表面平直、光亮，无油斑或其他杂物，无目视可见的氧化物及氮化物，无皱边、孔眼、裂缝、折痕、压线等缺陷，允许有轻微的加工条纹和辊印。锂带的边缘整齐，无裂口，无分层和夹杂。

The surface of lithium ribbon is flat and bright, there are no oil spots, visible oxides and nitride, wrinkles, holes, cracks, creases, trace, other sundries or other defects on the surface, while slight processing stripes and roller printing are allowed. The edge of the lithium ribbon is neat, there are no cracks, no stratification and inclusion at the edge of lithium ribbon.

包 装
Packaging

内包装：将锂带卷绕在塑料卷取盘上，在干燥环境中充高纯氩气密封包装于已干燥 24h 以上的五层铝塑复合袋中。铝塑复合袋外套缓冲减震泡泡袋，分层摆好。外包装：钢桶密封。

Inner packing: The lithium ribbon is wound around the plastic coiling and sealed in five-layers aluminum-plastic composite bag that has been dried for more than 24h with high-purity argon in the dry environment. The aluminum composite bag is covered with cushioned foam, and is placed in layers. Outer packing: Seal with steel drum.

储 存
Storage

锂带应密闭隔绝空气保存，注意防潮、防水，远离热源、火源及氧化性物质；保存期为六个月。

Lithium ribbon should be sealed off from air, moisture, water, heat sources, source of ignition and oxidizing substances; The shelf life of lithium ribbon is six months.

锂硼合金
Lithium-Boron Alloy

产品综述
Product summary

锂硼合金为多孔隙结构的脆性 Li_7B_6 基体相和韧性 Li 填充相组成的一种复合材料，密度 0.88±0.04g/cm^3，外观为银白色金属，极不稳定，遇空气易变质，遇水反应剧烈。锂硼合金主要应用于锂系热电池负极材料，具有高比能量、高比功率和低极化、电化学电位与纯锂相近，600℃以上仍为固态等突出优点，是新型锂系热电池的极佳负极材料。与目前广泛使用的锂硅合金相比，锂硼合金作为负极材料所装配的单元电池在最高电压和放电工作时间这两方面具有更好的性能。

Lithium boron alloy is a kind of composite material composed of Li_7B_6 matrix phase with porous structure and Li toughness filling phase, with a density of 0.88±0.04g/cm^3. It has a silver-white metal appearance and is extremely unstable. It is easy to deteriorate when exposed to air and react violently when exposed to water. Lithium boron alloy has advantages of high specific energy, high specific power, low polarization and high melting point, what's more, its electrochemical potential is similar with that of pure lithium, which makes the lithium boron alloy become excellent anode material for the new thermal battery. Compared with the lithium silicon alloy which is widely used in thermal battery at present, the lithium boron alloy as the anode material of thermal battery has better performances in the highest voltage and discharging time.

化学成分
Chemical composition

牌号 Category	锂含量（wt%） Mass fraction of lit hium	镁含量（wt%） Mass fraction of magnesium	硼含量（wt%） Mass fraction of boron
Li55	55±2	≤4	余量 the residue
Li60	60±2	≤4	余量 the residue
Li65	65±2	≤4	余量 the residue

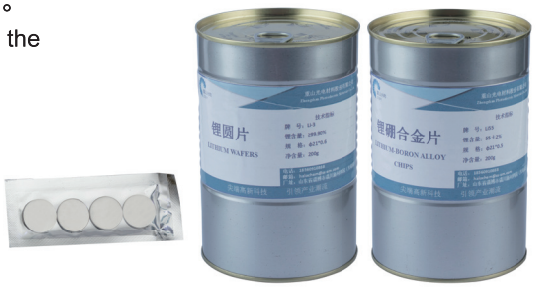
尺寸规格
Dimensions

宽度（mm） Width range	厚度（mm） Thickness range	宽度允许偏差（mm） Allowable deviation of width	厚度允许偏差（mm） Allowable deviation of thickness
60～100	0.4～1.8	±0.2	±0.015
备注：产品尺寸规格可依据客户商定要求确定。 Remark:The dimensions of products can be determined according to customers' requirements.			

表面质量
Surface quality

产品表面光亮、平整、无氧化和油斑，为银灰色质软金属带材。

The product is a soft silver-gray metal chip or strip, the surface of the product is bright and smooth without oxidation and oil spots.



热稳定性
Thermal stability

产品在 600℃条件下保持稳定固体形态，无锂渗漏。

The product is stable without liquid lithium outflowing at 600℃.

包装、储存
Packaging and storage

包装采用开顶金属圆罐或采用铝塑复合袋充干燥氩气密封。本品应密闭隔绝空气保存，注意防潮、防水，远离热源、火源及氧化性物质。

The product is packaged with open-top round metal cans or aluminum-plastic composite bag filled with dry argon sealed. The product should be sealed off from air, moisture, water, heat sources, source of ignition and oxidizing substances.

锂硅合金
Lithium-Silicon Alloy

产品综述
Product summary

锂硅合金其主相为 $Li_{13}Si_4$，外观为深灰色金属固体粉末，性质极不稳定，遇水强烈反应产生大量热并且放出氢气，在潮湿空气中会自燃。锂硅合金作为热电池负极材料，因其安全性、稳定性及成本低等优点，是目前用量最大的热电池负极材料。用锂硅合金作负极材料的热电池，较钙系、镁系热电池体系有着大功率放电、高比能量、激活迅速、贮存期长及结构紧凑等优点，特别适合大电流脉冲放电，是火炮、导弹理想电源之一。

The main phase of lithium silicon alloy is $Li_{13}Si_4$, lithium silicon alloy is dark gray metal solid powder, and its property is extremely unstable, it reacts strongly with water to produce large amounts of heat and hydrogen, spontaneously ignites in moist air. Due to its advantages of safety, stability and low cost, lithium silicon alloy is the most commonly used anode material of thermal battery. Compared with calcium and magnesium thermal battery system, thermal battery using lithium silicon alloy has the advantages of high power discharging, high specific energy, quick activation, long storage period and compact structure, etc., it is one of the ideal power sources for artilleries and missiles.

化学成分
Chemical composition

牌号 Category	Li 质量分数 % Mass fraction of Li	Si 质量分数 % Mass fraction of Si
Li-Si	44±2	56±2

粒度规格
Particle size

产品粒度一般控制 D50 值在 45-150um，具体粒度大小由供需双方商定。

Generally, D50 value of product granularity is 45-150um. The particle size should be determined by supply and requisitioning parties.

外观质量
Apprearance

产品为银灰色金属粉末，无团聚，无目视可见夹杂物。

The product is silver-gray metal powder without agglomeration and visible inclusions.

包装、储存
Packaging and storage

锂硅合金包装于清洁、干燥的铝瓶中，以高纯氩气密封。本品应密闭隔绝空气保存，注意防潮、防水，远离热源、火源及氧化性物质。

Lithium-silicon alloy is packaged with clean and dry aluminum bottles, sealed with high purity argon. The product should be sealed off from air, moisture, water, heat sources, source of ignition and oxidizing substances.

六氟磷酸锂
Lithium Hexafluorophosphate

产品综述
Product summary

六氟磷酸锂($LiPF_6$)为白色结晶或粉末，易溶于水，可溶于低浓度的甲醇、乙醇、碳酸酯等有机溶剂，熔点为 200℃，相对密度为 1.50 g/cm^3。六氟磷酸锂是电解液成分中重要的组成部分，约占到电解液总成本的 43%。与 $LiBF_4$、$LiAsF_6$、$LiClO_4$ 等电解质相比，六氟磷酸锂在有机溶剂中的溶解度、电导率、安全性和环保性方面具有优势，是目前应用范围最广的锂盐。

Lithium hexafluorophosphate ($LiPF_6$) is a white crystal or powder, soluble in water, soluble in low concentration of methanol, ethanol, carbonate and other organic solvents, melting point is 200℃ , the relative density of 1.50 g/cm^3. $LiPF_6$ is an important component of electrolyte, accounting for about 43% of the total cost of electrolyte. Compared with $LiBF_4$, $LiAsF_6$, $LiClO_4$ and other electrolytes, lithium hexafluorophosphate has advantages in solubility, conductivity, safety and environmental protection in organic solvents, and is the most widely used lithium salt at present.

产品指标
Quality specification

项目 Items	单位 Units	指标 Specification
六氟磷酸锂 Lithium hexafluorophosphate	ω/%	≥ 99. 95
碳酸二甲酯（DMC）不溶物 Dimethyl carbonate	ω/%	≤ 0. 0200
水分 Moisture	ω/%	≤ 0. 0020
游离酸（以 HF 计）Free acid	ω/%	≤ 0. 0090
硫酸盐（以 SO_4 计）Sulfate	mg/kg	≤ 5
氯化物（以 Cl 计）Chlorid	mg/kg	≤ 2
Fe	mg/kg	≤ 2
K	mg/kg	≤ 1
Na	mg/kg	≤ 2
Ca	mg/kg	≤ 2
Cd	mg/kg	≤ 1
Cr	mg/kg	≤ 1
Cu	mg/kg	≤ 1
Mg	mg/kg	≤ 1
Ni	mg/kg	≤ 1
Pb	mg/kg	≤ 1
Zn	mg/kg	≤ 1
As	mg/kg	≤ 1

四氟硼酸锂
Lithium Tetrafluoroborate

产品综述
Product summary

四氟硼酸锂 ($LiBF_4$) 为白色或微黄色粉末，极易溶于水，在碳酸酯溶剂、醚类化合物中有很好的溶解性，熔点在 293−300℃之间，相对密度为 0.852 g/cm^3。四氟硼酸锂具有较好的化学稳定性和热稳定性，主要作为 $LiPF_6$ 基电解质体系添加剂，改善循环寿命，提高锂离子电池性能。在电解液中添加 $LiBF_4$ 之后可拓宽锂离子电池的工作温度范围，提高电池的高低温放电性能。

Lithium Tetrafluoroborate ($LiBF_4$) is white or yellowish powder, easily soluble in water, carbonate solvent and ethers compounds. The melting point of $LiBF_4$ is 293-300℃ , with the relative density of 0.852g/cm^3.$LiBF_4$ has excellent chemical and thermal stability and is mainly used as an additive in $LiPF_6$ based electrolyte system to improve cycle life and performance of lithium batteries. By adding $LiBF_4$ to the electrolyte, the operating temperature range of the lithium battery can be broadened and the high-low temperature discharge performance of the battery can be improved.

产品指标
Quality specification

项目 Items	单位 Units	指标 Specification
四氟硼酸锂 Lithium tetrafluoroborate	ω/%	≥ 99. 9
水分 Moisture	ω/%	≤ 0. 0050
硫酸盐（以 SO_4 计）Sulfate	mg/kg	≤ 30
氯化物（以 Cl 计）Chlorid	mg/kg	≤ 30
铁（Fe）Iron	mg/kg	≤ 10
钾（K）Kalium	mg/kg	≤ 30
钠（Na）Sodium	mg/kg	≤ 30
钙（Ca）Calcium	mg/kg	≤ 30
铅（Pb）Plumbum	mg/kg	≤ 10

重山光电

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MATERIALS

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