

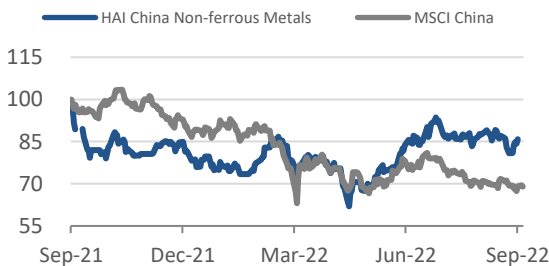
## 中国有色金属 China Non-ferrous Metals

### 赣锋锂业的固态电池之路

## The Solid-state Battery Road of Ganfeng Lithium

观点聚焦 Investment Focus

股票名称	评级	股票名称	评级
紫金矿业	Outperform	东阳光	Outperform
天齐锂业	Outperform	金力永磁	Outperform
赣锋锂业	Outperform	驰宏锌锗	Outperform
华友钴业	Outperform	川能动力	Outperform
洛阳钼业	Outperform	锡业股份	Outperform
山东黄金	Outperform	盛屯矿业	Outperform
中矿资源	Outperform	立中集团	Outperform
石英股份	Outperform	安宁股份	Outperform
天华超净	Outperform	博威合金	Outperform
南山铝业	Outperform	甬金股份	Outperform
格林美	Outperform	万丰奥威	Outperform
神火股份	Outperform	宁波韵升	Outperform
横店东磁	Outperform	贵研铂业	Outperform
赤峰黄金	Outperform	鑫铂股份	Outperform
银泰黄金	Outperform	盛达资源	Outperform
铜陵有色	Outperform		



资料来源: Factset, HTI

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(Please see APPENDIX 1 for English summary)

#### 深耕多年，产研结合到收获季节

2017 年，赣锋锂业与中科院宁波材料所合作共建“固体电解质材料工程中心”，聘请许晓雄博士为首席科学家，引进以他为核心的研发团队，正式切入固态电池研发板块。2018 年，该合作团队宣布固态电池的研发取得新的突破，纳米先导专项“全固态电池”课题通过验收，并在同年 8 月正式启动固态锂电池中试生产线建设项目。

赣锋锂电全资子公司浙江锋锂聚焦于高能量密度、高安全性能固态锂电池的研发和市场推广，在固态电池及相关材料领域已布局国内专利 150 余项，国际专利 5 项，获授权专利近 80 项，在国内固态电池领域排名前列。

#### 押注氧化物路线，固态电池产品性能优秀

赣锋锂电的固态电池采用氧化物厚膜技术路线，公司第一代混合固液电解质电池产品以三元为正极，采用柔性固态电解质，以石墨为负极，能量密度达 235 ~ 280Wh/kg，业已实现装车应用。第二代固态锂电池采用三元正极、固态隔膜和含金属锂负极材料，目前该产品能量密度超过 350Wh/kg，循环寿命接近 400 次。赣锋锂业第一代、二代固态电池为固液混合电池技术，即半固态电池产品，赣锋认为，在未来几年，固液混合的半固态电池将是主要趋势之一。

#### 赣锋锂业的固态电池产业化进程

我们认为公司在 2022 年开始加大固态电池产线投建力度的另一个原因是下游市场的扩大。公司第一代固态电池在东风 E70 电动车上实现装车，另一个采用固态电池的明星车型蔚来 ET7 1000 公里续航版本也计划在 2022-2023 年交付。我们认为固态电池的装车之路已经打开，公司亟需扩大产能已应对市场扩张。

在电动车市场之外，固态电池在储能领域也取得了突破。9 月 6 日，小米发布了旗下首款户外电源产品米家户外电源 1000Pro，意味着小米正式进军移动储能市场。其搭载了 1 度电的电力储备，支持 1800W 正弦波输出，1.5 小时快充，双 100WPD 快充。1000Pro 搭载了混合固液电解质电池，能量密度超过 500Wh/L，循环充放 1000 次电池容量仍大于 80%，半固态电池的使用场景持续拓宽。

综上，我们认为赣锋锂业的固态电池业务将在未来几年高速发展，成为公司业绩增长的重要一极。

#### 风险提示

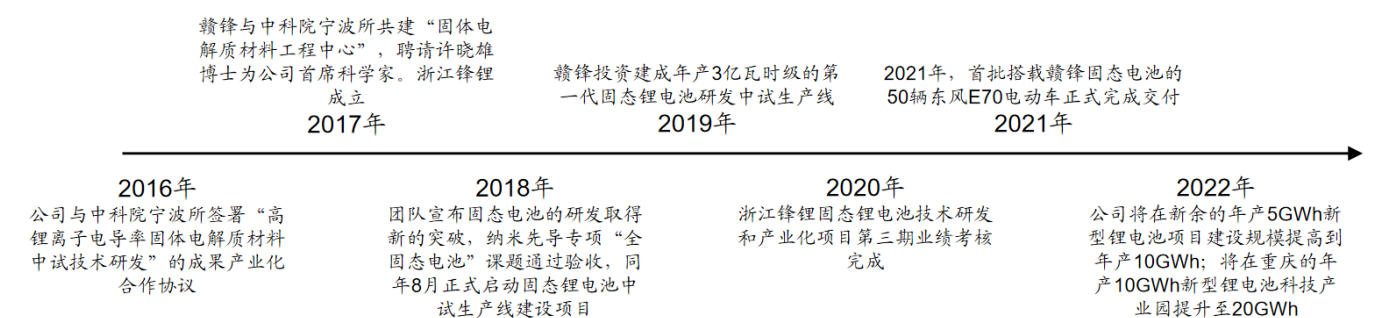
新能源汽车销量增长不及预期。

## 1. 深耕多年，产研结合到收获季节

自 2017 年以来，赣锋锂业结合自身在电池产业链中积累的各方面优势，斥巨资提前进行固态电池布局，近几年持续获得业内人士广泛关注。

2016 年 9 月，中科院宁波材料技术与工程研究所与赣锋锂业签署“高锂离子电导率固体电解质材料中试技术研发”的成果产业化合作协议。2017 年，赣锋锂业与中科院宁波材料所合作共建“固体电解质材料工程中心”，聘请许晓雄博士为公司首席科学家，并引进以其为核心的研发团队，正式切入到固态电池研发板块。2018 年，该合作团队宣布固态电池的研发取得新的突破，纳米先导专项“全固态电池”课题通过验收，并在同年 8 月正式启动固态锂电池中试生产线建设项目。

图1 赣锋锂业固态电池业务大事记



资料来源：赣锋锂业公告，中科院宁波所官网，海通国际

公司固态电池研发团队的核心是许晓雄博士，许博士 2007 年 7 月在中国取得中国科学院上海硅酸盐研究所理学博士学位，2017 年 4 月加入公司，现任公司第四届董事会董事、首席科学家，同时兼任公司附属公司浙江锋锂、宁波力赛康总经理，主要负责固态锂电池产品的研发和产业化工作，是中国硅酸盐学会固态离子学分会会员及中国化工学会储能工程专业委员会委员，在材料科学方面拥有逾 20 年的研究经验。

固态锂电池业务是赣锋锂电动力电池业务板块未来发展的重点，赣锋锂电全资子公司浙江锋锂聚焦于高能量密度、高安全性能固态锂电池的研发和市场推广，在固态电池及相关材料领域已布局国内专利 150 余项，国际专利 5 项，获授权专利近 80 项，在国内固态电池领域排名前列。

表1 赣锋锂业全资子公司浙江锋锂持有专利部分情况

专利名称	申请公布号	专利类型	法律状态	申请公布日
一种正极及高安全高循环性的锂金属固态电池	CN114373884A	发明专利	--	2021-12-15
一种用于固态锂电池的含碳硫化物固体电解质及制备方法	CN112768762A	发明专利	实审	2021-02-26
一种固态电池用正极片或负极片的制备方法、固态电池用正极片或负极片、固态电池	CN111799514A	发明专利	实审	2020-07-11
一种用于软包锂电池封装的顶封头结构	CN211404619U	实用新型	有效-授权	2019-11-04
一种新型的锂金属负极高电压正极的固液电池	CN110931843A	发明专利	实审	2019-10-28
锂金属负极及其制备方法及制备全固态电池的方法	CN110085868A	发明专利	实审	2019-04-25
一种固态电池电解质膜及其制备方法和带有该电解质膜的固态电池	CN109286039A	发明专利	实审	2018-10-22
一种全固态电池一体化模块及包含该模块的全固态电池	CN108598557A	发明专利	实审	2018-05-22

资料来源：Wind，公司公告

## 2.押注氧化物路线，固态电池产品性能优秀

赣锋锂电的固态电池采用氧化物技术路线，公司第一代混合固液电解质电池产品以三元为正极，采用柔性固态电解质，以石墨为负极，能量密度达 235~280Wh/kg，业已实现装车应用。第二代固态锂电池采用三元正极、固态隔膜和含金属锂负极材料，目前该产品能量密度超过 350Wh/kg，循环寿命接近 400 次。目前赣锋锂电第一代、第二代固态电池为固液混合电池技术，也即半固态电池产品，赣锋认为，在未来几年，这种固液混合的半固态电池将是主要趋势之一。

相比普遍使用的锂离子电池和锂离子聚合物电池，固态电池使用固体电极和固体电解质，能量密度大幅提升。另外，在安全性能方面，因采用固态电解质，在固固反应中减少了可燃气体的排放，且没有可燃的电解液等材料。许博士团队生产的第一代半固态电池安全性较现有相同体系的传统锂离子电池大幅提升，较好地破解了当前三元锂电池高能量密度与高安全不兼容的矛盾。得益于半固态电池在安全性上的提高，我们认为赣锋的固态电池可以采用软包的包装技术，这也有助于提升公司电池产品的能量密度。

根据浙江锋锂的业绩考核完成情况，到 2018 年底，单体容量大于 30Ah 的第一代固态锂电池系列电芯试制完成，综合性能指标达到研制品水平；40Ah 固态锂电池产品定型，产品的安全指标和综合性能通过内部测试，达到研制品水平。

表2 浙江锋锂项目业绩考核期完成情况

考核期间	业绩考核指标	完成情况
2018年6月30日	<ul style="list-style-type: none"> <li>第一代固态锂电池技术指标达到：单体容量 10Ah，能量密度不低于 240Wh/kg，1000 次循环后容量保持率大于 90%，电池单体具备 5C 倍率的充放电能力；</li> <li>电池研制品通过第三方机构安全检测</li> </ul>	<ul style="list-style-type: none"> <li>项目第一期业绩考核指标达标</li> </ul>
2018年12月31日	<ul style="list-style-type: none"> <li>试制出单体容量大于 30Ah 的第一代固态锂电池系列电芯，综合性能指标达到研制品水平；</li> <li>年产亿瓦时级的第一代固态锂电池研发中试生产线建成投产，稳定运行，达到设计产能；</li> <li>实现二家以上的客户送样</li> </ul>	<ul style="list-style-type: none"> <li>40Ah 固态锂电池产品定型，产品的安全指标和综合性能通过内部测试，达到研制品水平；</li> <li>年产亿瓦时级的第一代固态锂电池研发中试生产线正在建设中；</li> <li>向多家国内外知名车企送样测试，正在进行客户量产导入前工作</li> </ul>
2019年12月31日	<ul style="list-style-type: none"> <li>第一代固态锂电池销售额超过 3 亿元人民币，扣除固定资产折旧和研发费用后子公司实现盈亏平衡；</li> <li>第二代固态锂电池技术指标达到：能量密度不低于 300Wh/kg；综合性能指标达到国际领先水平；</li> </ul>	<ul style="list-style-type: none"> <li>第一代固态锂电池销售额未达到考核要求；</li> <li>经权威第三方机构检测，第二代固态锂电池样品能量密度达到 350Wh/kg，循环次数超过 200 次；</li> <li>第三代固态锂电池技术的可行性研究工作持续稳步推进中</li> </ul>

资料来源：Wind，公司公告，海通国际

### 3.赣锋锂业的固态电池产业化进程

作为国内领先的固态电池研发团队和锂电材料企业，赣锋锂业在推动固态电池产业化方面不遗余力。2017年12月，公司以自有资金不超过2.5亿元投资建设一条年产亿瓦时级的第一代固态锂电池研发中试生产线，开展第一代产品在新能源汽车用户的推广和市场投放，项目建设期2年。该项目将加快推进公司新型高安全固态动力锂电池的技术研发和产业化进程，推动公司锂产业链结构的优化升级。

2019年，公司投资建成年产3亿瓦时级的第一代固态锂电池研发中试生产线；2022年1月，首批搭载赣锋固态电池的50辆东风E70电动车正式完成交付，实测续航超400公里。赣锋锂电率先实现固态锂电池产业化，并与东风首次实现装车运行，对推动我国锂电产业进一步发展具有重要意义。

图2 赣锋锂电固态电池列装东风E70



资料来源：汽车之家，海通国际

图3 赣锋锂电-东风汽车联合开发历史



资料来源：汽车之家，海通国际

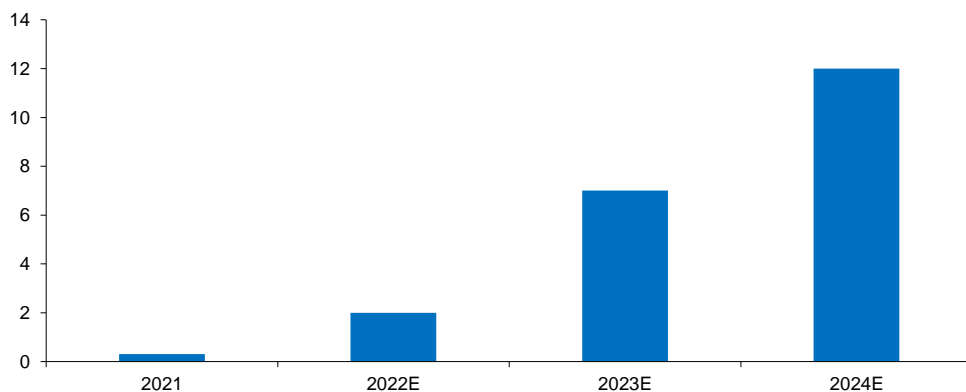
除东风汽车外，2022年8月，公司与广汽埃安签署战略合作协议，与辽宁曙光汽车集团签署战略合作协议。与车企联系的不加深，也有助于公司固态电池产品市场的拓宽。

随着公司在第一代、第二代固态电池技术方面趋于成熟，2022年开始，公司加大了在固态电池领域的投资，产能加速扩张。

2022年8月，公司公告将赣锋锂电在江西新余高新技术产业开发区的年产5GWh新型锂电池项目建设规模提高到年产10GWh，项目总投资为不超过62亿元，计划在2023年10月全部工程竣工投产。

赣锋还将在重庆两江新区的年产10GWh新型锂电池科技产业园及先进电池研究院项目建设规模提高到年产20GWh。项目总投资不超过96亿元，计划在签订《交地纪要》之日起3个月内开工建设，开工建设之日起18个月内完成竣工备案，竣工备案后6个月内投产。在重庆的锂电产业园中将会建设第二代固态锂电池。

图4 赣锋锂业固态电池产能 (GWh)



资料来源：赣锋锂业公告，海通国际

我们认为公司在 2022 年开始加大固态电池产线投建力度的另一个原因是下游市场的扩大。公司第一代固态电池在东风 E70 电动车上实现装车，迈出了固态电池产业化的第一步。另一个采用固态电池的明星车型蔚来 ET7 1000 公里续航版本也计划在 2022-2023 年交付。我们认为固态电池的装车之路已经打开，公司亟需扩大产能已应对市场扩张。

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图5 蔚来 ET7 1000 公里续航版本



资料来源：蔚来汽车官网，海通国际

图6 米家户外电源 1000Pro



资料来源：小米商城，海通国际

综上，我们认为赣锋锂业的固态电池业务将在未来几年高速发展，成为公司业绩增长的重要一极。

#### 4. 风险提示

新能源汽车销量增长不及预期。

## APPENDIX 1

### Summary

After many years of deep cultivation, the combination of production and research into the harvest season

In 2017, Ganfeng Lithium and Ningbo Institute of Materials, Chinese Academy of Sciences jointly established the "Solid Electrolyte Materials Engineering Center", hired Dr. Xu Xiaoxiong as the chief scientist, introduced a research and development team with him as the core, and officially entered the solid-state battery research and development sector. In 2018, the cooperative team announced a new breakthrough in the research and development of solid-state batteries, and the nano-pilot special "all-solid-state battery" project passed the acceptance, and in August of the same year, the pilot production line construction project for solid-state lithium batteries was officially launched.

Zhejiang Feng Li, a wholly-owned subsidiary of Ganfeng Lithium, focuses on the research and development and marketing of solid-state lithium batteries with high energy density and high safety performance. It has deployed more than 150 domestic patents and 5 international patents in the field of solid-state batteries and related materials, and has been authorized Nearly 80 patents, ranking the forefront in the domestic solid-state battery field.

Betting on the oxide route, solid-state battery products have excellent performance

The solid-state battery of Ganfeng Lithium Battery adopts the oxide thick film technology route. The company's first-generation mixed solid-liquid electrolyte battery products use ternary as the positive electrode, use a flexible solid-state electrolyte, and use graphite as the negative electrode, with an energy density of 235-280Wh/kg, having realized the loading application. The second-generation solid-state lithium battery uses a ternary positive electrode, a solid-state separator and a metal-containing lithium negative electrode material. At present, the energy density of the product exceeds 350Wh/kg, and the cycle life is close to 400 times. At present, the first- and second-generation solid-state batteries of Ganfeng Lithium are solid-liquid hybrid battery technology, that is, semi-solid battery products. Ganfeng believes that in the next few years, this kind of solid-liquid hybrid semi-solid battery will be the main trend.

Ganfeng Lithium's solid-state battery industrialization process

We believe that another reason why the company will start to increase the construction of solid-state battery production lines in 2022 is the expansion of the downstream market. The company's first-generation solid-state battery was installed on the Dongfeng E70 electric vehicle, and the 1,000-kilometer NIO ET7, another star model using solid-state batteries, is also scheduled to be delivered in 2022-2023. We believe that the loading road of solid-state batteries has been opened, and the company urgently needs to expand production capacity to cope with market expansion.

Outside the electric vehicle market, solid-state batteries have also made breakthroughs in energy storage. On September 6, Xiaomi released its first outdoor power supply product, Mijia Outdoor Power Supply 1000Pro, which means Xiaomi officially entered the mobile energy storage market. It is equipped with a power reserve of 1 kWh, supports 1800W sine wave output, 1.5-hour fast charge, and dual 100WPD fast charge. The 1000Pro is equipped with a hybrid solid-liquid electrolyte battery with an energy density of over 500Wh/L, and the battery capacity is still greater than 80% after 1,000 cycles of charging and discharging. The usage scenarios of semi-solid batteries continue to expand.

In summary, we believe that Ganfeng Lithium's solid-state battery business will develop rapidly in the next few years and become an important pole of the company's performance growth.

Risk warning

Sales of new energy vehicles grew less than expected.

## 附录 APPENDIX

### 重要信息披露

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各地股票基准指数: 日本 – TOPIX, 韩国 – KOSPI, 台湾 – TAIEX, 印度 – Nifty100, 美国 – SP500; 其他所有中国概念股 – MSCI China.

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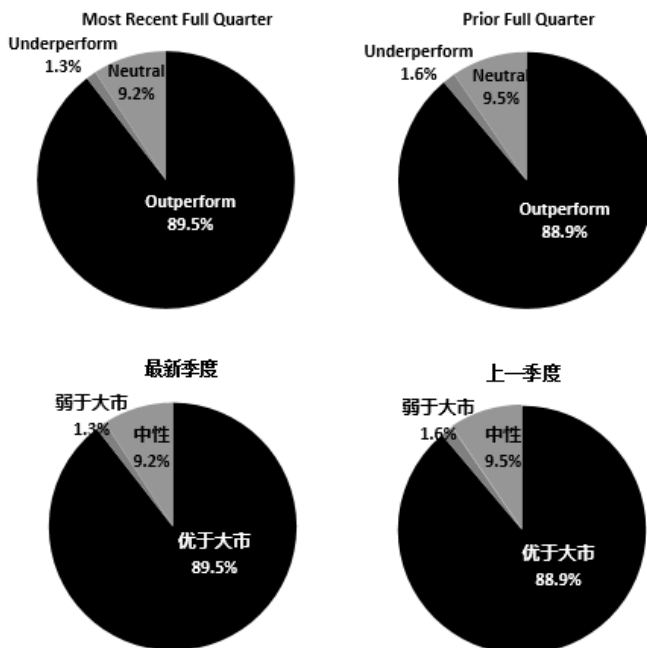
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**Benchmarks for each stock's listed region are as follows: Japan – TOPIX, Korea – KOSPI, Taiwan – TAIEX, India – Nifty100, US – SP500; for all other China-concept stocks – MSCI China.**

**评级分布 Rating Distribution**



**截至 2022 年 6 月 30 日海通国际股票研究评级分布**

	优于大市	中性 (持有)	弱于大市
海通国际股票研究覆盖率	89.5%	9.2%	1.3%
投资银行客户*	5.9%	5.6%	5.0%

\*在每个评级类别里投资银行客户所占的百分比。

上述分布中的买入, 中性和卖出分别对应我们当前优于大市, 中性和落后大市评级。

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买入, 未来 12-18 个月内预期相对基准指数涨幅在 10%以上, 基准定义如下



中性，未来 12-18 个月内预期相对基准指数变化不大，基准定义如下。根据 FINRA/NYSE 的评级分布规则，我们会将中性评级划入持有这一类别。

卖出，未来 12-18 个月内预期相对基准指数跌幅在 10%以上，基准定义如下

各地股票基准指数：日本 – TOPIX, 韩国 – KOSPI, 台湾 – TAIEX, 印度 – Nifty100; 其他所有中国概念股 – MSCI China.

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	Outperform	Neutral (hold)	Underperform
HTI Equity Research Coverage	89.5%	9.2%	1.3%
IB clients*	5.9%	5.6%	5.0%

\*Percentage of investment banking clients in each rating category.

BUY, Neutral, and SELL in the above distribution correspond to our current ratings of Outperform, Neutral, and Underperform.

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**SELL:** The stock's total return over the next 12-18 months is expected to be below the return of its relevant broad market benchmark, as indicated below.

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