

中国有色金属 China Non-ferrous Metals

PET 铜箔浅析

Analysis of PET Copper Foil

观点聚焦 Investment Focus

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

(Please see APPENDIX 1 for English summary)

1. 传统铜箔：电极材料需要新思路：

电解铜箔有多重隐患，带来新电极材料的需求。

2. PET 材料带来新思路：PET 铜箔的产生：

PET 材料有许多优点，相比传统铜箔，PET 铜箔在各个环节都有了全面的提升，市场潜在规模大。

3. 传统铜箔 VS PET 铜箔：

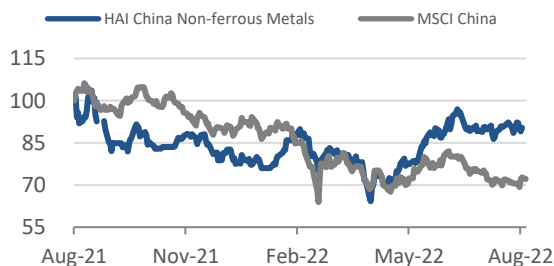
在安全、寿命、兼容性、成本等方面有显著提升。

4. 战略意义：PET 铜箔替代传统铜箔的可能性：

各公司开启战略布局。

5. 风险提示：

处于前期投产，生产效率低，产量规模较小。



资料来源：Factset, HTI

金云涛 Yuntao Jin
yt.jin@htisec.com

Yijie Wu
lisa.yj.wu@htisec.com

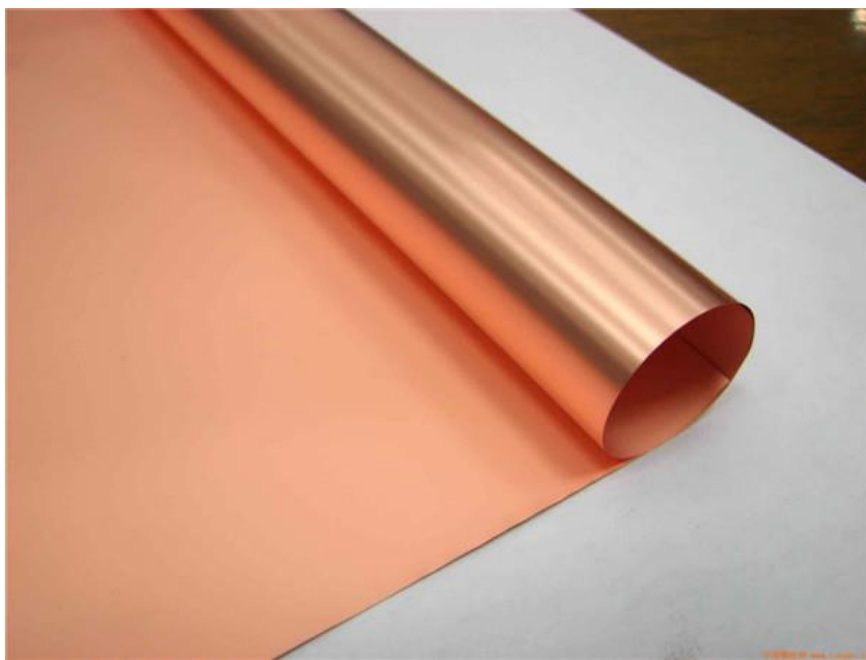
一、传统铜箔：电极材料需要新思路

1.1 传统铜箔及其分类

铜箔是锂电池中关键性的导电材料，是一种阴质性电解材料，沉淀于电路板基底层上的一层薄的、连续的金属箔。

铜箔有多种分类方式，根据厚度可以分为：厚铜箔(大于 70 μm)、常规厚度铜箔(大于 18 μm 而小于 70 μm)、薄铜箔(大于 12 μm 而小于 18 μm)、超薄铜箔(小于 12 μm)等；根据表面状况可以分为：单面处理铜箔(单面毛)、双面处理铜箔(双面粗)、光面处理铜箔(双面毛)、双面光铜箔(双光)和甚低轮廓铜箔(VLP 铜箔)铜箔等。

图表1 传统铜箔示意图

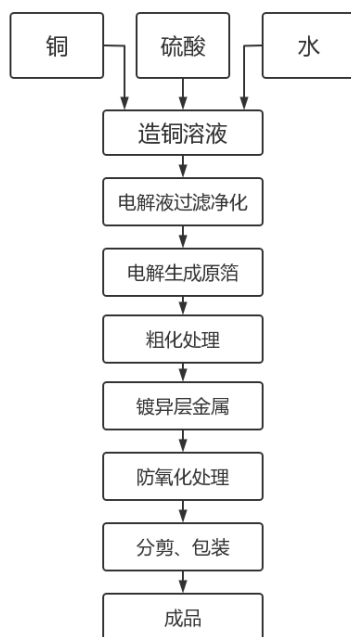


资料来源：电池中国网，海通国际

1.2 传统铜箔制作原理

电解铜箔生产的方法：目前国内多采用辊式阴极、不溶性阳极以连续法生产电解铜箔。

图表2 辊式连续电解法生产电解铜箔的工艺流程图



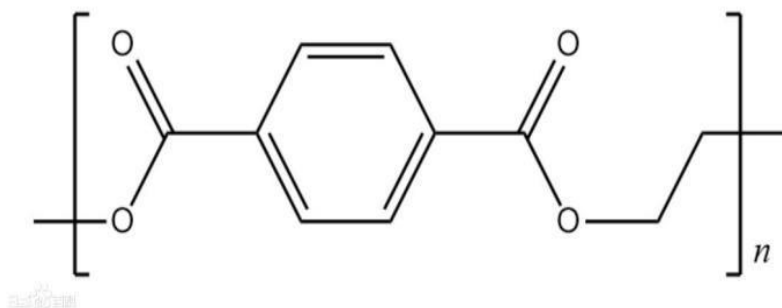
资料来源：公众号锂电时代，海通国际

二、PET 材料带来新思路：PET 铜箔的产生

2.1 PET 材料：多个优点

聚对苯二甲酸乙二醇酯（PET），化学式为 $(C_{10}H_8O_4)_n$ ，是由对苯二甲酸二甲酯与乙二醇酯交换或以对苯二甲酸与乙二醇酯化先合成对苯二甲酸双羟乙酯，然后再进行缩聚反应制得。在较宽的温度范围内具有优良的物理机械性能，长期使用温度可达 120°C ，电绝缘性优良，甚至在高温高频下，其电性能仍较好，但耐电晕性较差，抗蠕变性，耐疲劳性，耐摩擦性、尺寸稳定性都很好。

图表3 PET 分子式



资料来源：百度百科，海通国际

图表4 PET 材料示意图



资料来源：百度百科，海通国际

优点：

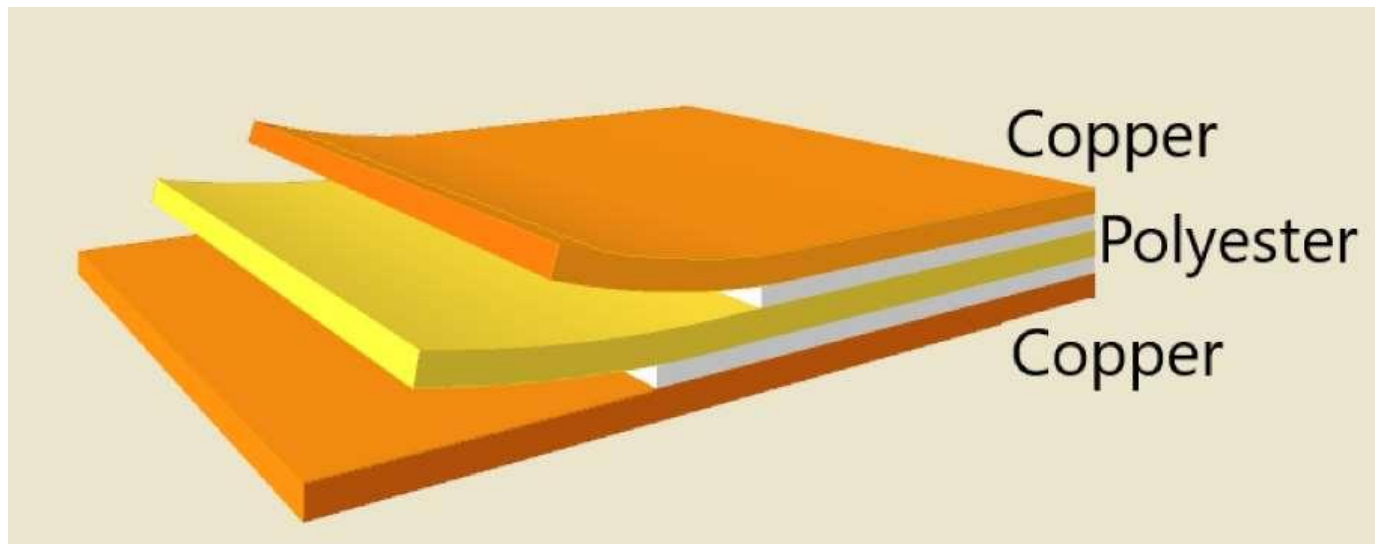
- 1.有良好的力学性能，冲击强度是其他薄膜的 3-5 倍，耐折性好。
- 2.耐油、耐脂肪、耐稀酸、稀碱，耐大多数溶剂。
- 3.可在 55-60°C 温度范围内长期使用，短期使用可耐 65°C 高温，可耐 -70°C 低温，且高、低温时对其机械性能影响很小。
- 4.气体和水蒸气渗透率低，既有优良的阻气、水、油及异味性能。
- 5.透明度高，可阻挡紫外线，光泽性好。

2.2 PET 铜箔产生：制作原理

复合铜箔是在基材厚度 3-8 μm 的 PET、PP、PI 等材质表面采用磁控溅射的方式，制作一层 30-70nm 的金属层，方阻约为 0.5-2 欧姆，实现基材表面金属化。然后通过水电镀增厚的方式，将金属层加厚到 1 μm 或以上，制作总厚度在 5-10 μm 的复合铜箔，用以代替 4.5-9 μm 的电解铜箔。

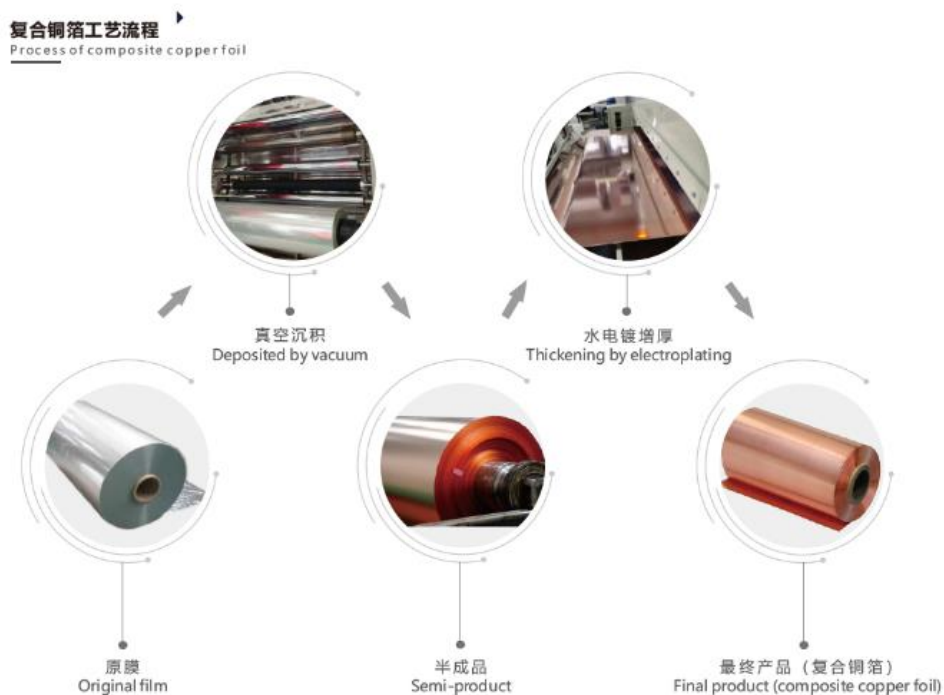
举例而言，1 个 4.5 μm 的电解铜箔可以等价视为 3 μm 的 PET+上下两层各 1 μm 的电镀铜。所以如果单用电解铜（电镀铜）的厚度来反应成本的话，则 PET 铜箔耗铜量较电解铜箔减少 = $2\mu\text{m}/4.5\mu\text{m}-1=-55.6\%$ 。这样的成本下降是可观的。

图表5 PET 铜箔示意图



资料来源: PIETRO GALLIAN, 海通国际

图表6 PET 铜箔工艺流程



资料来源: 广东腾胜科技创新有限公司官网, 海通国际

三、传统铜箔 VS PET 铜箔

与传统的铜箔相比，PET 复合铜箔有五个优点：

- 1.安全性高：金属受到应力之后很容易断裂，断裂之后容易刺穿隔膜，造成内短路引起发热失控。PET 不容易断，金属断裂之后也不容易刺穿 PET 膜。PET 铜箔在刺穿测试中可以做到只冒烟不起火的状态。
- 2.能量密度高：PET 铜箔铜含量少、聚酯质量轻，部分铜被塑料取代，减少了电池的重量，增加了电池的能量密度。
- 3.寿命长：减少金属收缩引起的活性物质脱落，可提高电池的循环寿命。
- 4.兼容性强：可以适用不同规格、不同系统的电池。
- 5.成本低：铜箔占锂电池成本约为 8%-10%，PET 铜箔所用铜量大大减少，生产规模扩大后，还有进一步的下降空间。

四、战略意义：PET 铜箔替代传统铜箔的可能性

重点公司：

- 1.东威科技：2021 年年报显示，正启动项目开发适合产业化发展的磁控溅射类双面镀铜镀膜设备。与生产的水电镀设备工艺密切衔接，打造一体化 PET 复合铜膜生产线，制定合理的镀膜工艺。
- 2.双星新材：2022 年 7 月 26 日在投资者互动平台表示，公司的 pet 镀铜膜目前进展顺利，已经送样进行客户认证，镀铜基膜已经对外销售。
- 3.万顺新材：2022 年 7 月 8 日在投资者互动平台表示，公司已开展铜膜开发工作，并开发出应用于电池负极的铜膜样品送下游电池企业验证，目前正在配合下游的需求优化产品工艺。
- 4.阿石创：2022 年 8 月 9 日在投资者互动平台表示，复合铜箔为公司正在研项目之一。
- 5.重庆金美新材料：主打产品高分子复合导电铝箔和高分子复合导电铜箔，是目前全球新能源市场上同时做到解决安全性、提升能量密度、降低制造成本的产品，为新能源行业提供了成熟的材料端底层解决方案。
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五、风险提示

处于前期投产，生产效率低，产量规模较小。

APPENDIX 1

Summary

1. Traditional copper foil: new ideas are needed for electrode materials: electrolytic copper foil has multiple hidden dangers, which brings the demand for new electrode materials.
2. PET material brings new ideas: generation of pet copper foil: PET material has many advantages. Compared with traditional copper foil, pet copper foil has been comprehensively improved in all aspects, and the market potential is large.
3. Traditional copper foil vs pet copper foil: significantly improved in safety, life, compatibility and cost.
4. Strategic significance: the possibility of replacing traditional copper foil with pet copper foil: each company starts its strategic layout.
5. Uncertainty analysis: it is in the early stage of production, with low production efficiency and small output scale.

附录 APPENDIX

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优于大市, 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。

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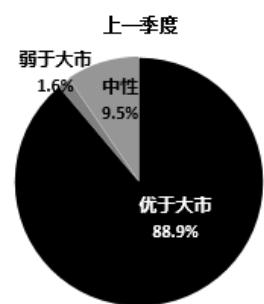
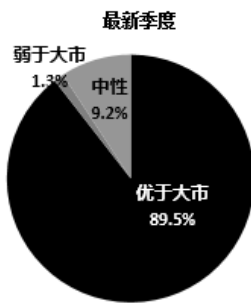
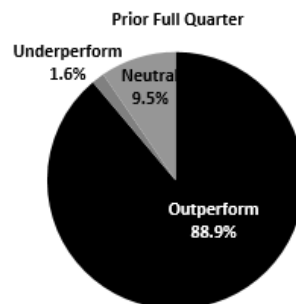
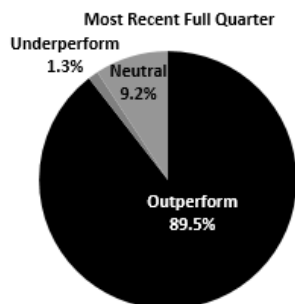
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Neutral: The stock's total return over the next 12-18 months is expected to be in line with the return of its relevant broad market benchmark, as indicated below. For purposes only of FINRA/NYSE ratings distribution rules, our Neutral rating falls into a hold rating category.

Underperform: 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.

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。
只有根据 FINRA/NYSE 的评级分布规则，我们才将中性评级划入持有这一类别。请注意在上表中不包含非评级的股票。

此前的评级系统定义（直至 2020 年 6 月 30 日）：

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.

Haitong International Equity Research Ratings Distribution, as of Jun 30, 2022

	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.

For purposes only of FINRA/NYSE ratings distribution rules, our Neutral rating falls into a hold rating category. Please note that stocks with an NR designation are not included in the table above.

Previous rating system definitions (until 30 Jun 2020):

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

NEUTRAL: The stock's total return over the next 12-18 months is expected to be in line with the return of its relevant broad market benchmark, as indicated below. For purposes only of FINRA/NYSE ratings distribution rules, our Neutral rating falls into a hold rating category.

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.

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

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