The information and statistics presented in this section and other sections of this document, unless otherwise indicated, were extracted from different official government publications and other publications, and from the industry report prepared by Frost & Sullivan, an independent market research and consulting company that was commissioned by us, in connection with this **[REDACTED]**. *The information from official government sources has not been independently verified by us, the Sponsors,* **[REDACTED]**, *any of their respective directors and advisers, or any other persons or parties involved in the* **[REDACTED]**, *and no representation is given as to its accuracy.*

SOURCES OF INFORMATION

We engaged Frost & Sullivan, an independent market research consultant, to conduct an analysis of, and to prepare a report on both the global and China's advanced functional current collector market for use in this document (the "**F&S Report**"), which was commissioned by us for a fee of RMB990,000. In compiling and preparing the F&S Report, Frost & Sullivan adopted the following assumptions: (i) the social, economic and political conditions globally currently discussed will remain stable during the forecast period, (ii) global government policies on the advanced functional current collector market will remain consistent during the forecast period, (iii) both the global advanced functional current collector market will be driven by the factors which are stated in the report for the forecast period. Except as otherwise noted, all of the data and forecasts contained in this section are derived from the F&S Report. The F&S Report has been prepared by Frost & Sullivan independently without any influence from us or other interested parties.

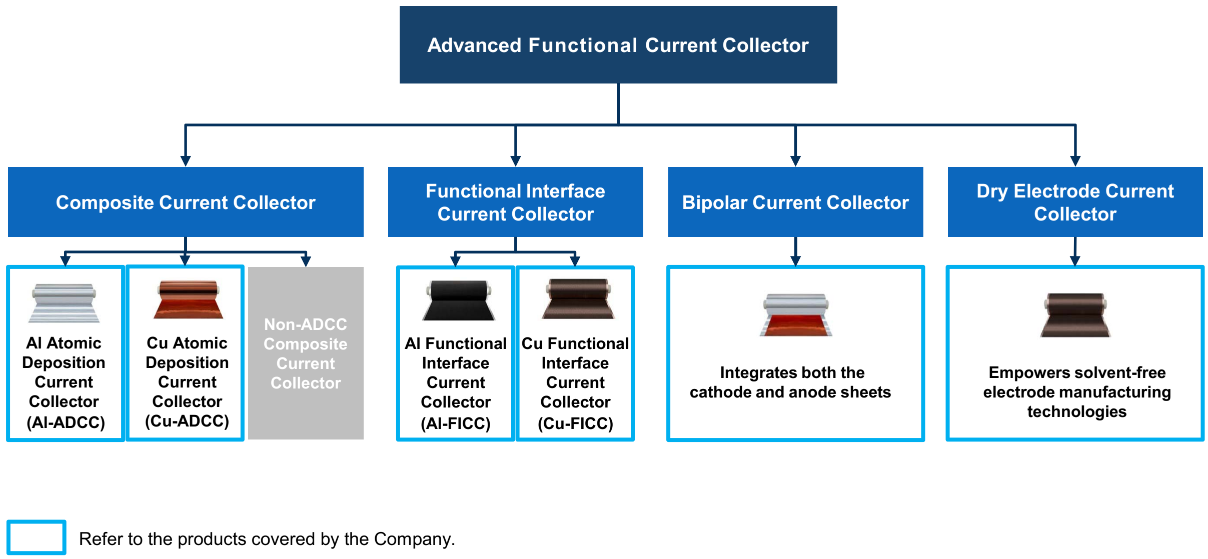
DEFINITION AND DOWNSTREAM OVERVIEW OF ADVANCED FUNCTIONAL CURRENT COLLECTOR

Definition and Classification of Advanced Functional Current Collector

As new energy materials, advanced functional current collectors are critical components in advanced battery technologies, designed to enhance performance, efficiency and durability, and lower cost. Compared with traditional current collectors made of pure Cu and Al foils, which primarily serve as passive conductive substrates, advanced functional current collectors integrate additional structural, electrical or thermal functionalities to enhance overall cell performance. Advanced functional current collectors are primarily categorized into four types, namely composite current collectors, functional interface current collectors, bipolar current collectors and dry electrode current collectors. Advanced functional current collectors play a vital role in addressing the evolving demands of high-performance battery systems, supporting applications in EV, energy storage, consumer and other emerging areas.

Composite current collectors adopt a "metal-polymer-metal" sandwich structure and incorporate circuit-blocking and flame-retardant materials to enhance safety while reducing battery cell cost by reducing the consumption of metals. Among them, atomic deposition current collectors use advanced techniques to apply ultrathin, uniform metal coatings, representing a technologically advanced category within composite current collectors. Functional interface current collectors feature nanoscale surface coatings on traditional or composite current collectors that improve safety, support fast charging and discharging, and extend battery cycle life. Bipolar current collectors are key materials that enable simplified bipolar cell structures, which increases energy density, and support ultrafast charging and discharging. Dry electrode current collectors are key materials that enable enhanced lamination strength and support next-generation, solvent-free green electrode manufacturing.

Classification of Advanced Functional Current Collectors



Source: Frost & Sullivan

Value Chain of Advanced Functional Current Collectors

The upstream of the advanced functional current collector value chain includes raw materials such as polymer films, including BOPET, PP, and PI, coating slurry and metal materials, including Cu and Al targets, along with related equipment such as magnetron sputtering devices, vacuum coating machines, and electroplating equipment. The midstream consists of manufacturing companies that process these upstream materials into advanced functional current collector products through various technologies and processes. The advanced functional current collectors then proceed through battery cell production, followed by their application in major sectors such as EV, energy storage, consumer, and other emerging areas.

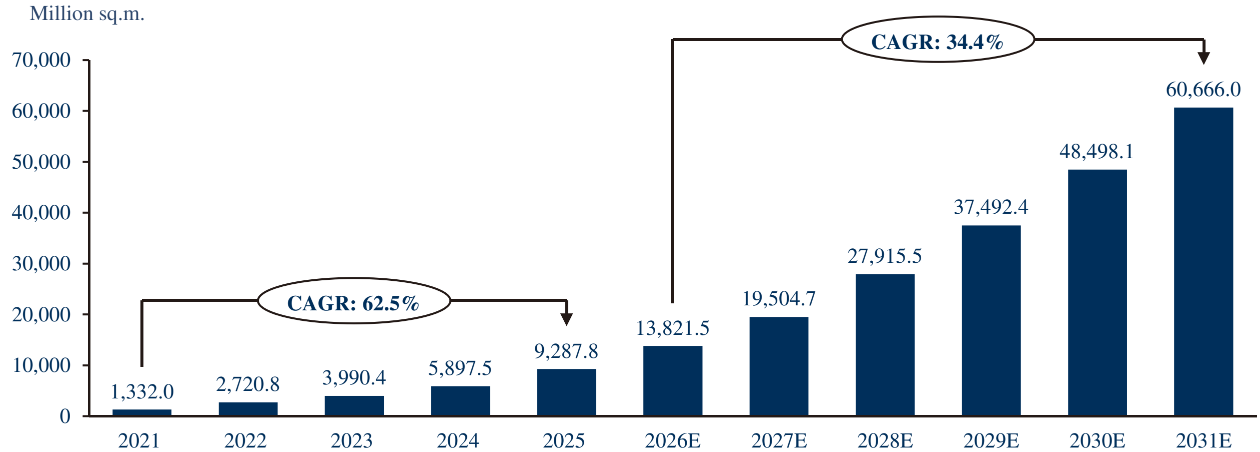
Market Size of Global Lithium-ion Battery Industry

The global lithium-ion battery market is experiencing strong growth across EV, energy storage system, and consumer sectors. The global shipment volume of lithium-ion batteries increased from 554.0 GWh in 2021 to 2,224.6 GWh in 2025, representing a CAGR of 41.6%. With ongoing technological advancements and cost reductions, the lithium-ion battery market is expected to expand further. It is expected that shipments of lithium-ion batteries will reach 8,235.0 GWh by 2031, with a CAGR of 21.9% between 2026 and 2031.

ANALYSIS OF THE ADVANCED FUNCTIONAL CURRENT COLLECTOR MARKET

Driven by the need to improve interface stability and enhance fast-charging capability, along with market demand for EV, energy storage, consumer batteries and other emerging areas, advanced functional current collectors are seeing rapid adoption in next-generation lithium-ion batteries. Global consumption increased from 1,332.0 million sq.m. in 2021 to 9,287.8 million sq.m. in 2025, and is expected to reach 60,666.0 million sq.m. by 2031, representing a CAGR of 34.4% from 2026 to 2031.

Consumption Volume of the Advanced Functional Current Collector Market*, Global, 2021–2031E



Source: Frost & Sullivan

**Note:*

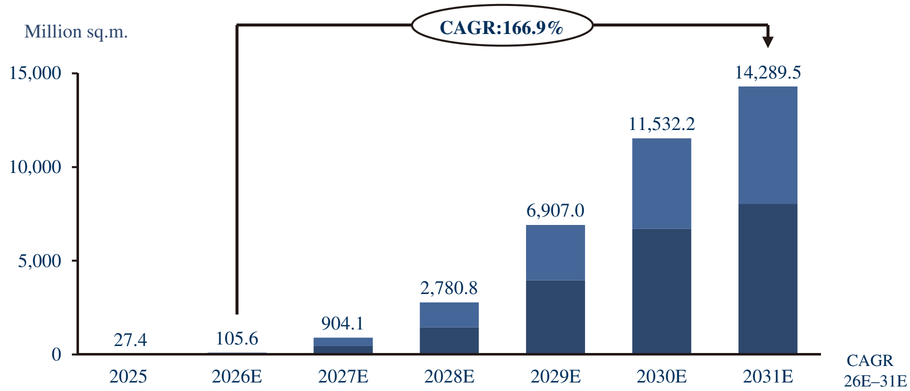
(1) Consumption volume includes external procurement from materials suppliers and in-house supply of battery companies.

(2) The market size of functional interface current collectors is converted from a ton-based unit to a square-meter-based unit.

Market Size and Drivers of the Global Composite Current Collector Market

CATL began exploring composite current collector concepts in 2015 and later clarified its technical approach in a 2017 patent, which outlined the use of vacuum evaporation or magnetron sputtering processes for composite current collector manufacturing. Against this technological background, the global composite current collector market has entered its commercialization phase, with 2024 considered as the initial year of this product. Driven by the growing demand for enhanced safety performance, high energy density and reduced overall battery weight, the global consumption volume of composite current collectors is expected to increase from 105.6 million sq.m. in 2026 to 14,289.5 million sq.m. in 2031, representing a CAGR of 166.9% from 2026 to 2031. Within this, the global consumption volume of Cu composite current collectors is expected to reach 8,029.3 million sq.m. by 2031, mainly driven by their cost efficiency. The global consumption volume of Al composite current collectors is projected to reach 6,260.2 million sq.m. by 2031, mainly supported by their safety requirement and improvements in performance. In 2025, the penetration rate of Cu composite current collectors was 0.02% and is projected to reach 8.5% by 2031, while the penetration rate of Al composite current collectors is at 0.1% in 2025 and is expected to reach 6.6% by 2031.

Consumption Volume of the Composite Current Collector Market*
(by material type), Global, 2025–2031E

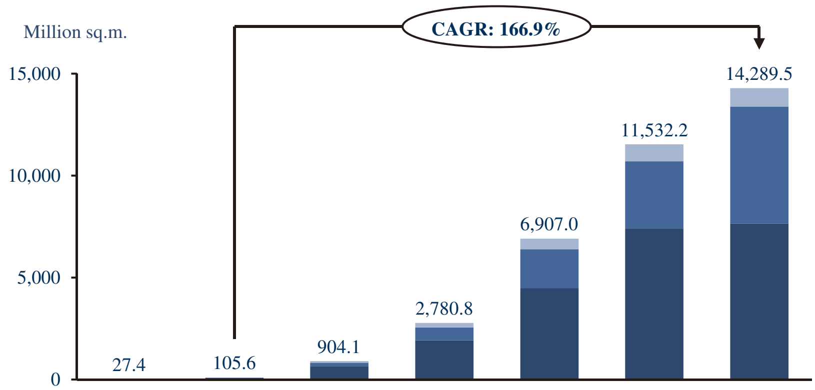


	2025	2026E	2027E	2028E	2029E	2030E	2031E	CAGR 26E–31E
Cu Composite Current Collector	6.1	52.8	463.1	1,456.6	3,966.7	6,703.2	8,029.3	173.2%
Al Composite Current Collector	21.3	52.8	441.0	1,324.2	2,940.3	4,829.0	6,260.2	159.9%

Source: Frost & Sullivan
**Note: Consumption volume includes external procurement from materials suppliers and in-house supply of battery companies.*

In terms of breakdown by end-use applications, the global consumption volume of composite current collectors in EV batteries is expected to reach 7,659.7 million sq.m. by 2031, driven by the increasing demand for high energy density, improved safety, and lightweight design in EVs. The global consumption volume of composite current collectors in energy storage batteries is projected to reach 5,730.0 million sq.m. by 2031, supported by the growing deployment of large-scale energy storage systems and the need for cost reduction. The global consumption volume of composite current collectors in consumer batteries is anticipated to rise to 899.8 million sq.m. by 2031, driven by the increasing demand for thinner, safer, lighter, and more efficient power sources in portable electronics.

Consumption Volume of the Composite Current Collector Market*
(by application), Global, 2025–2031E



	2025	2026E	2027E	2028E	2029E	2030E	2031E	CAGR 26E–31E
EV Battery	22.3	80.7	659.6	1,919.0	4,488.0	7,417.7	7,659.7	148.6%
Energy Storage Battery	2.5	15.2	167.7	639.9	1,900.0	3,282.2	5,730.0	227.6%
Consumer Battery	2.7	9.7	76.8	221.9	518.0	832.2	899.8	147.6%

Source: *Frost & Sullivan*
**Note:* *Consumption volume includes external procurement from materials suppliers and in-house supply of battery companies.*

Development Trends of Composite Current Collector Market

- ***Thinner Foil Designs to Optimize Energy Density and Material Use.*** Development is trending toward ultrathin composite current collector, often below 6 μm in total thickness, to meet the need to reduce inactive materials and enhance gravimetric energy density. Advances in lamination technologies have enabled consistent manufacturing of thinner collectors without sacrificing conductivity or mechanical durability. This trend aligns with the broader industry push to optimize cell design and reduce the overall weight of battery packs, especially in EVs and portable devices.

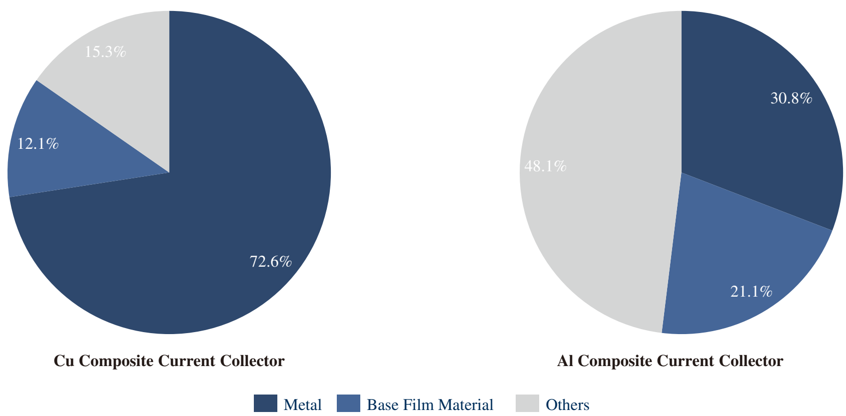
- ***Advancement of Solid-State Batteries.*** As solid-state batteries move toward commercialization, composite current collectors are expected to become increasingly important due to their ability to stabilize solid–solid interfaces and reduce internal resistance. Solid electrolytes impose stricter requirements on mechanical compliance and surface compatibility, as interface contact can be disrupted by thermal expansion and contraction or stress accumulation during cycling. Composite structures, including multilayer and polymer-reinforced designs, improve adhesion, buffer mechanical deformation, and limit interfacial degradation. These advantages support higher energy density and enhanced safety, and as manufacturers accelerate pilot production of solid-state cells, demand for composite current collectors is projected to grow accordingly.

- ***Improvement of Supply Chain Support and Cost Optimization.*** As the market for composite current collectors expands, the supply chain continues to improve, supporting the advancement of industrialization and cost optimization. A larger market scale attracts more upstream and downstream participants, fostering competition and encouraging investment in production capacity. Enhanced supply chain coordination improves material and equipment availability, reduces procurement lead times, and streamlines logistics. These developments lower manufacturing costs and increase production efficiency, making customized raw materials and equipment more accessible to composite current collector manufacturers, and composite current collector products and services more accessible to battery manufacturers.

Cost Analysis of the Composite Current Collector Market

The raw material cost of composite current collectors mainly consists of the base film material, metal material, and adhesive or coating materials. Common base films include PP or BOPET, while the metals used are typically Cu or Al. In the early stages of their development the supply of base film materials for composite current collectors primarily relied on imports. This supply structure is expected to gradually shift toward domestic producers.

Cost Analysis of Composite Current Collectors, Global, 2025



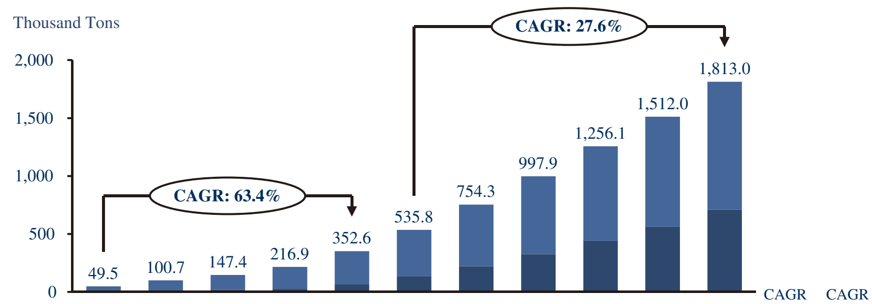
Source: Frost & Sullivan

ANALYSIS OF THE FUNCTIONAL INTERFACE CURRENT COLLECTOR MARKET

Market Size and Drivers of the Global Functional Interface Current Collector Market

Driven by the need for improved conductivity, better interface stability, and enhanced fast-charging performance, functional interface current collectors have seen growing adoption in advanced lithium-ion batteries. The global consumption volume of functional interface current collectors increased from 49.5 thousand tons in 2021 to 352.6 thousand tons in 2025, and is expected to reach 1,813.0 thousand tons in 2031, representing a CAGR of 27.6% from 2026 to 2031. Due to the differences of Al and Cu functional interface current collectors, the market potential also varies. Al-FICC is expected to achieve higher penetration due to lower processing complexity. The consumption volume of Al-FICC is projected to reach 1,102.6 thousand tons by 2031, supported by their suitability for lithium iron phosphate and solid-state battery systems. Meanwhile, the consumption volume of Cu-FICC is expected to reach 710.4 thousand tons by 2031, driven by their excellent electrical performance after long cycle and compatibility with high-capacity anode materials. In 2025, the penetration rate of Al-FICC is 44.4% and is expected to reach 62.8% by 2031, while the penetration rate of Cu-FICC is 6.5% in 2025 and is projected to reach 26.4% by 2031.

Consumption Volume of the Functional Interface Current Collector Market* (by material type), Global, 2021–2031E

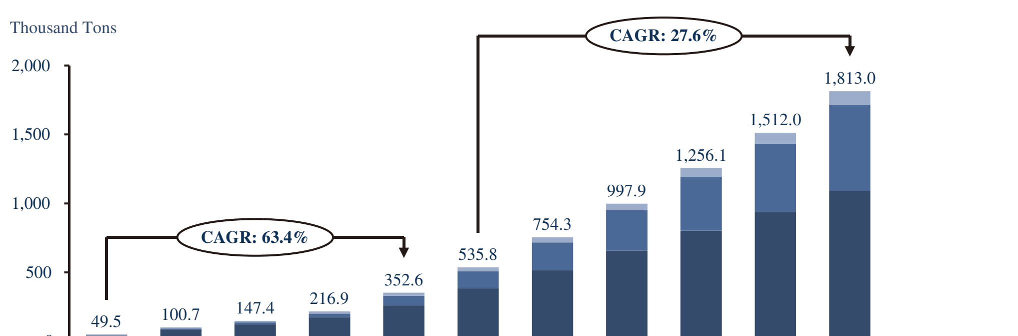


	2021	2022	2023	2024	2025	2026E	2027E	2028E	2029E	2030E	2031E	CAGR 21–25	CAGR 26E–31E
Cu Functional Interface Current Collector	6.7	12.9	18.1	25.5	68.6	134.1	221.1	325.4	441.7	562.1	710.4	78.8%	39.6%
Al Functional Interface Current Collector	42.7	87.8	129.3	191.4	284.0	401.7	533.2	672.5	814.4	949.9	1,102.6	60.5%	22.4%

Source: Frost & Sullivan
**Note: Consumption volume includes external procurement from materials suppliers and in-house supply of battery companies.*

In terms of breakdown by end-use applications, the global consumption volume of functional interface current collectors in EV batteries is expected to reach 1,090.7 thousand tons by 2031, driven by the growing demand for fast charging capability, enhanced interface stability, and improved energy efficiency in EVs. The global consumption volume of functional interface current collectors in energy storage batteries is projected to reach 626.3 thousand tons by 2031, supported by the increasing need for long cycle life, high safety standards, and stable performance in grid-scale applications. In consumer batteries, global consumption volume is anticipated to rise to 96.1 thousand tons by 2031, driven by the demand for high-performance, compact power sources in mobile and wearable electronic devices.

Consumption Volume of the Functional Interface Current Collector Market* (by application), Global, 2021–2031E



	2021	2022	2023	2024	2025	2026E	2027E	2028E	2029E	2030E	2031E	CAGR 21–25	CAGR 26E–31E
EV Battery	40.7	84.7	122.6	174.3	261.4	383.9	517.0	657.6	802.1	937.3	1,090.7	59.2%	23.2%
Energy Storage Battery	2.5	7.9	14.1	25.9	69.0	122.9	199.9	291.8	392.4	497.5	626.3	130.4%	38.5%
Consumer Battery	6.3	8.1	10.6	16.7	22.2	28.9	37.5	48.4	61.6	77.2	96.1	36.8%	27.2%

Source: Frost & Sullivan
**Note: Consumption volume includes external procurement from materials suppliers and in-house supply of battery companies.*

Development Trends of Functional Interface Current Collector Market

- ***Customization of Coating Materials for Electrolyte Compatibility.*** Advanced R&D efforts are being directed toward tailoring nano carbon-coating chemistries, such as carbon, metal oxides, or polymer composites, to optimize interactions with various electrolyte systems, including Na-ion and dry-electrode types. This customization enhances interface stability, reduces parasitic reactions, and prolongs battery life. This trend reflects the broader push toward battery chemistries with improved safety and performance under diverse operational environments.

- ***Rising Interface Performance Requirements of Solid-State Batteries.*** As solid-state batteries move toward commercialization, functional interface current collectors are expected to gain traction due to their ability to stabilize solid–solid interfaces and accommodate mechanical stress arising from thermal expansion mismatch. Their engineered surface layers and compliant coatings help maintain interfacial contact, reduce resistance growth, and mitigate delamination during cycling. These characteristics support higher energy density electrode designs and improve overall reliability. With industry efforts accelerating in solid-state battery development, demand for functional interface current collectors is projected to increase accordingly.

- ***Adaptation for Ultra-High Voltage Cathode Chemistries.*** With the shift toward ultra-high voltage cathode materials, Al-FICC is being refined to withstand oxidative stress and prevent electrolyte decomposition at the interface. Competition between NCM and LFP cathode chemistries also influences material selection and coating strategies, as each system imposes different requirements on voltage tolerance, interfacial stability, and cost performance. Research is focusing on coating uniformity and ionic conductivity to ensure efficient charge transfer without compromising structural stability. This trend supports the demand batteries for long-range EVs and durable grid storage solutions.

OVERVIEW OF OTHER ADVANCED FUNCTIONAL CURRENT COLLECTOR MARKETS

Overview of Bipolar Current Collector Market

A bipolar current collector is a key material for next-generation battery systems, featuring a specialized electrode design in which a single conductive substrate connects the cathode on one side and the anode on the other, enabling direct series stacking of cells without external wiring. This design fundamentally improves energy density and system compactness while enhancing thermal management and overall safety. By integrating both electrodes into one structure, bipolar current collectors reduce internal resistance, simplify assembly, and support efficient heat dissipation. They also enable ultra high rate charge and discharge. Owing to these advantages, they are considered a key enabling component for next-generation battery architectures such as solid-state batteries. Toyota had outlined a roadmap for the commercialization of bipolar batteries as early as 2023.

Driven by the growing demand for higher system integration, enhanced energy density, and simplified battery pack design, the global consumption volume of bipolar current collectors is projected to reach 2,229.4 million sq.m. by 2031. This growth is supported by their ability to reduce internal resistance, improve thermal management, and enable more compact battery architectures, particularly in applications such as EVs and large-scale energy storage.

Overview of Dry Electrode Current Collector

Current collectors for dry electrode applications are specially engineered conductive metal foils, such as Cu or Al, that enable the application of dry electrode technology in lithium-ion batteries through solvent-free manufacturing processes. The dry process eliminates the need for solvents and slurry, reducing environmental impact, lowering production costs, and improving overall cell performance. Compared with conventional collectors used in wet processes, dry process-compatible collectors feature enhanced surface roughness, improved coating adhesion, and greater mechanical flexibility to ensure uniform material transfer and stable electrode integrity. These properties make them well-suited for high-loading electrodes and next-generation, solvent-free electrode manufacturing technologies.

In 2024, Tesla stated that dry electrode technology is a core method for achieving cost reduction and that it plans to further advance this process in future battery generations. Driven by demand for environmentally friendly manufacturing processes, improved energy density, and reduced production costs in next-generation battery technologies, the global consumption volume of dry electrode current collectors is projected to reach 4,087.3 million sq.m. by 2031.

FUTURE DEVELOPMENT TRENDS OF COMPOSITE METAL FOILS

The future prospects for composite metal foils extend beyond their current use in lithium-ion batteries. Composite metal foils have the potential to serve as an alternative to conventional metal foils across a broad range of applications, which can fulfill the typical functional requirements of traditional metal foils and provide additional premium features. With their advantages in cost reduction, lightweight characteristics, and mechanical strength, composite foils are expected to find broader applications in areas such as aerospace and high-efficiency photovoltaic technologies. In these fields, the integration of metal foils with polymers or ceramics enables improved heat dissipation, signal shielding, and structural reliability. As manufacturing processes mature and costs decrease, composite metal foils are likely to play an increasingly important role in next-generation energy and electronics systems.

COMPETITIVE ANALYSIS OF ADVANCED FUNCTIONAL CURRENT COLLECTORS

Competitive Landscape of the Global Advanced Functional Current Collector Market

The global advanced functional current collector market features a concentrated landscape of established players with extensive manufacturing capabilities and strong distribution networks. Within the advanced functional current collector market, different manufacturers can focus on different advanced functional current collector products. As of 2025, composite current collector manufacturers are still in the early stage of commercialization, with bipolar current collector and dry electrode current collector manufacturers being before commercialization. In contrast, manufacturers of functional interface current collectors have already achieved commercialization. Therefore, the following shipment volume ranking analysis focuses on functional interface current collectors.

Competitive Landscape of the Global Composite Current Collector Market

The global composite current collector market is highly concentrated, with Chinese companies dominating. Leading firms leverage substantial capital to invest in R&D and attract top talent, erecting industry barriers through material patents and coating innovations. They enhance supply chain stability, control costs, and promote technological synergies through joint R&D and cooperation with upstream key equipment manufacturers and raw material suppliers. This integrated approach establishes an end-to-end supply chain from advanced research to customized battery solutions, propelling performance breakthroughs and market consolidation. With an annual production capacity of 62.9 million sq.m., we ranked first among manufacturers of composite current collectors globally as of December 31, 2025.

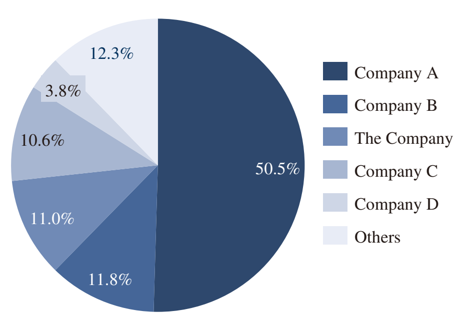
Competitive Landscape of Global Functional Interface Current Collector Market

The global functional interface current collector market is relatively competitive but is also highly concentrated. While its lower capital barrier attracts some small and medium-sized entrants, Chinese manufacturers establish barriers through core competencies including customized slurry formula, leverage strong resource integration capabilities to rapidly respond to customer demands, and translate coating expertise into scaled industrial applications to maintain dominance. Concurrently, leading players optimize costs to build end-to-end strength spanning material innovation to end applications, propelling both material performance breakthroughs and market consolidation.

Rankings of Functional Interface Current Collector Manufacturers

The functional interface current collector market is highly concentrated globally, with the top five manufacturers accounting for 87.7% of the market in 2025. With a shipment volume of 12.5 thousand tons in the global market in 2025, we ranked third among manufacturers of functional interface current collectors globally, with a market share of 11.0%.

Ranking of Functional Interface Current Collectors (by shipment volume)*, Global, 2025



Rank	Company Name	Shipment Volume (Thousand Tons)	Market Share
1	Company A	57.2	50.5%
2	Company B	13.4	11.8%
3	**The Company**	**12.5**	**11.0%**
4	Company C	12.1	10.6%
5	Company D	4.3	3.8%
	Others	13.9	12.3%
	Total	**113.4**	**100.0%**

Source: Frost & Sullivan

**Note: The ranking and market share are based on external materials suppliers without considering the internal supplies of battery manufacturers.*

Company A established in 2013 is a company headquartered in Guangzhou, and specializes in the R&D, production, and sales of new energy power battery materials covering aluminum foils, conductive coated current collectors, etc.

Company B established in 2007 is a subsidiary of a company listed on SSE, headquartered in Hangzhou, and engaged in the research, production and sales of various aluminum and aluminum alloy plates, strips, foils and their deep-processed products.

Company C established in 2004 is a company listed on SSE, headquartered in Foshan, and specializes in the R&D, manufacturing and sales of functional adhesive films, new energy carbon-coated foil, carbon nanotubes and application products.

Company D established in 2013 is a company headquartered in Shanghai, and specializes in the R&D, manufacturing and sales of functional coating materials for lithium-ion batteries.

Entry Barriers of Advanced Functional Current Collector

- ***Technology Barrier***. The advanced composite current collector industry is a highly technology-intensive field due to product complexity. Leading companies have accumulated extensive technical expertise and proprietary designs, while new entrants would face significant challenges. In addition, strong intellectual property protection and patent portfolios held by leading players create an additional barrier to entry, making it difficult for new companies to replicate technologies. In addition, the quality of composite current collectors directly affects the quality of lithium-ion batteries, particularly in terms of safety performance and energy density. Furthermore, leading companies possess strong R&D capabilities, enabling visionary development of next-generation materials and maintaining a diversified product pipeline that continuously strengthens their technological edge. Moreover, these leading players often engage in joint R&D of core production equipment, which enhances process precision, improves production efficiency, and further consolidates their technological advantage. Therefore, clients tend to choose advanced composite current collector providers with well-known brands and rich successful experience in providing similar services as their suppliers. For new entrants to the market, they require not only technical capabilities but also time to establish a good brand image.

- ***Capacity Barrier.*** Leading enterprises leverage large-scale production facilities to achieve significant economies of scale, substantially reducing per-unit manufacturing costs. In composite current collectors, scale advantages become even more critical due to the complex, defect-sensitive production processes, as only those with mature composite lines can supply large orders of consistent quality, which new entrants typically struggle to match. Additionally, leading companies also possess strong engineering and manufacturing capabilities, enabling commercialization of advanced functional current collector with industry-leading production efficiency. This operating efficiency not only enhances their competitive pricing power and first mover advantage but also ensures rapid response capabilities to meet fluctuating market demands. Consequently, established players can consistently secure bulk orders while maintaining high profitability, further cementing their market dominance against capacity-constrained new entrants.

- ***Talent Barrier.*** Advanced composite current collectors represent cutting-edge technology, requiring highly specialized talent in this field. It has a great demand for professionals expert in disciplines such as materials science, plasma physics, electrochemistry, and techniques such as vacuum coating and electrochemical deposition. Many professionals are required to undertake long-term education and training in these fields before formally participating in the different segments of the industry. Therefore, for new entrants of the market, the lack of professional expertise would be a great challenge in their early stages.