

INDUSTRY OVERVIEW

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SOURCE OF INFORMATION

We commissioned Frost & Sullivan to conduct market research on global electronic functional enhancement materials, acoustic enhancement materials, electronic ceramic powders, electronic adhesives, and energy enhancement materials industries and prepare the Frost & Sullivan Report. Frost & Sullivan is an independent global consulting firm founded in 1961 in New York that offers industry research and market strategies. We have contracted to pay RMB500,000 to Frost & Sullivan for compiling the Frost & Sullivan Report.

In preparing the Frost & Sullivan Report, Frost & Sullivan conducted detailed primary research which involved discussing the status of the industry with certain leading industry participants and conducting interviews with relevant parties. Frost & Sullivan also conducted secondary research which involved reviewing company reports, independent research reports and data based on its own research database. Frost & Sullivan obtained the figures for the estimated total market size from historical data analysis plotted against macroeconomic data as well as considered the above-mentioned industry key drivers. Its market engineering forecasting methodology integrates several forecasting techniques with the market engineering measurement-based system and relies on the expertise of the analyst team in integrating the critical market elements investigated during the research phase of the project. These elements primarily include expert-opinion forecasting methodology, integration of market drivers and restraints, integration with the market challenges, integration of the market engineering measurement trends and integration of econometric variables.

The Frost & Sullivan Report is compiled based on the following assumptions: (i) the social, economic and political environment of the globe and Chinese Mainland is likely to remain stable in the forecast period; and (ii) related industry key drivers are likely to drive the market in the forecast period.

OVERVIEW OF GLOBAL ELECTRONIC FUNCTIONAL ENHANCEMENT MATERIALS INDUSTRY

Definition and Characteristics of Electronic Functional Enhancement Materials

Electronic functional enhancement materials are primarily used to enhance acoustical, optical, thermal and electrical performance of components and devices. The specific application segments mainly served by electronic functional enhancement materials encompass diversified scenarios including consumer electronics, new energy, automotive electronics, semiconductors, computing power, and industrial and communications sectors. Electronic functional enhancement materials possess characteristics such as high growth potential, high performance, and high added value.

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Development Status and Trends Analysis of Global Electronic Functional Enhancement Materials Industry

AI Applications Driving the Advancement of Electronic Functional Enhancement Materials

Proliferation of AI is triggering the device upgrade and surging computing power demands. Consequently, consumer electronics and semiconductor industries are raising their standards for material properties, specifically requiring enhanced acoustical, optical, thermal, and electrical performance. The “Action Plan for Steady Growth of the Electronic Information Manufacturing Industry (2025-2026)” issued by the Ministry of Industry and Information Technology in 2025 proposes focusing on new electronic materials to strengthen intellectual property protection and promote sustainable innovation. It aims to accelerate the research and development process for electronic functional enhancement materials applied in high-performance smart terminals.

Brand Effects Propelling Cross-Sector Product Deployment

Leading enterprises possess in-depth technology platforms, continuously expanding electronic functional enhancement materials across multiple fields. Thus, these enterprises hold strong brand equity, catering to the needs of industry-leading clients and aligning with their diversified portfolio needs. Further, they achieve breakthroughs in key application scenarios, such as AI smartphones, foldable smartphones, AI glasses/XR devices, as well as semiconductor and computing power materials.

Innovation by Chinese Enterprises Promoting Global Industrial Development

Leading Chinese enterprises are transforming the electronic functional enhancement materials industry by leveraging localized supply chain to secure upstream stability while precisely matching downstream needs. Evolving beyond traditional market dominated by overseas participants, these Chinese enterprises have established comprehensive ecosystems integrating material design, process optimization, and customized application verification, thereby driving global industrial advancement.

OVERVIEW OF GLOBAL ACOUSTIC ENHANCEMENT MATERIALS INDUSTRY

Definition, Classification and Application Scenarios of Acoustic Enhancement Materials

Acoustic enhancement materials are key functional materials primarily applied in smart terminals including smartphones, tablets, laptops, smart wearables, and AI glasses/XR devices to improve, control, and enhance acoustic performance. These materials are currently used in speakers to accommodate the growing trend of smart terminals becoming thinner, lighter, and more miniaturized. Acoustic enhancement materials mainly fall into two categories: sound-adsorbing particles and other acoustic diaphragm functional enhancement materials. Both categories function within a limited space, allowing for large-amplitude designs that provide better sound quality. Sound-adsorbing particles, which mainly include N'BASS Materials, are classified as porous ceramic materials, specially designed to build a virtual back cavity for better acoustic performance. This fundamentally improves the issue of insufficient low-frequency output in micro-speakers within limited spaces, providing a brand-new pathway for enhancing the low-frequency performance of smart terminals. Acoustic diaphragm functional enhancement materials, on the other hand, improve the diaphragm's stiffness-to-mass ratio, structural stability, and dynamic response capabilities. Core functions of both sectors lie in achieving an overall improvement in sound quality, clarity, and acoustic stability.

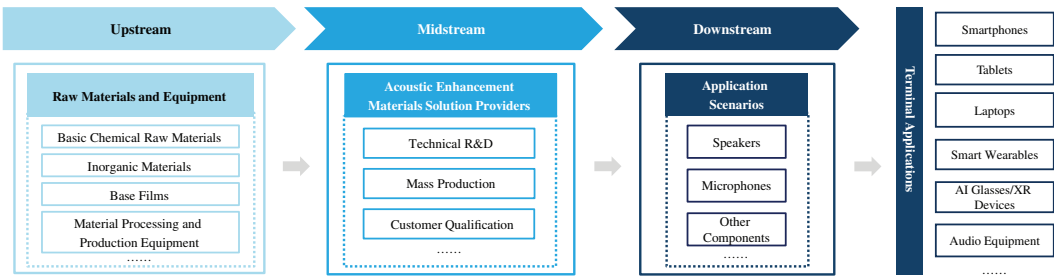
In terms of application scenarios, driven by the sustained demand for sound quality improvement in consumer electronics for AI interaction under the AI wave, sound-adsorbing particles have taken the lead in large-scale application within high-end smartphones. With the accelerated penetration of AI smartphones and foldable smartphones, their applications are expected to expand, gradually penetrating to more upper mid-end smartphone models, and accelerating the expansion into a broader range of consumer electronics smart terminals such as AI glasses/XR devices, tablets, and laptops.

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Value Chain Analysis of Acoustic Enhancement Materials Industry

The industrial chain structure of acoustic enhancement materials can be generally divided into three segments: upstream raw material and specialized equipment, midstream material preparation and technical services, and downstream terminal applications. The upstream segment is primarily composed of suppliers of key raw materials, such as basic chemicals, inorganic materials, base films, as well as providers of material processing and production equipment. The midstream segment consists of solution providers for acoustic enhancement materials, focusing on the industrialization of sound-adsorbing particles and other acoustic diaphragm functional enhancement materials; this covers core stages such as technical research and development, mass production, and customer qualification for acoustic enhancement materials and supporting products. The downstream segment is mainly comprised of electro-acoustic component manufacturers, with final products applied across various consumer electronics smart terminals’ brands, ultimately realizing the final verification and market commercialization of products.

Value Chain Analysis of Acoustic Enhancement Materials Industry



Source: Acoustical Society of China, European Acoustics Association, Frost & Sullivan

Market Size Analysis of Global Acoustic Enhancement Materials Industry

The demand for acoustic enhancement materials is highly dependent on the shipments of consumer electronics smart terminals. With accelerated product iterations for smartphones, tablets, laptops, smart wearables, AI glasses/XR devices — as well as the expansion of AI functions, continuous product innovation, and growing demand for multi-modal interaction — global shipments of consumer electronic smart terminals are expected to increase to 2,692.6 million units by 2030, representing a CAGR of 3.9% from 2025 to 2030, providing a solid market foundation for the market penetration and upgrading of acoustic enhancement materials.

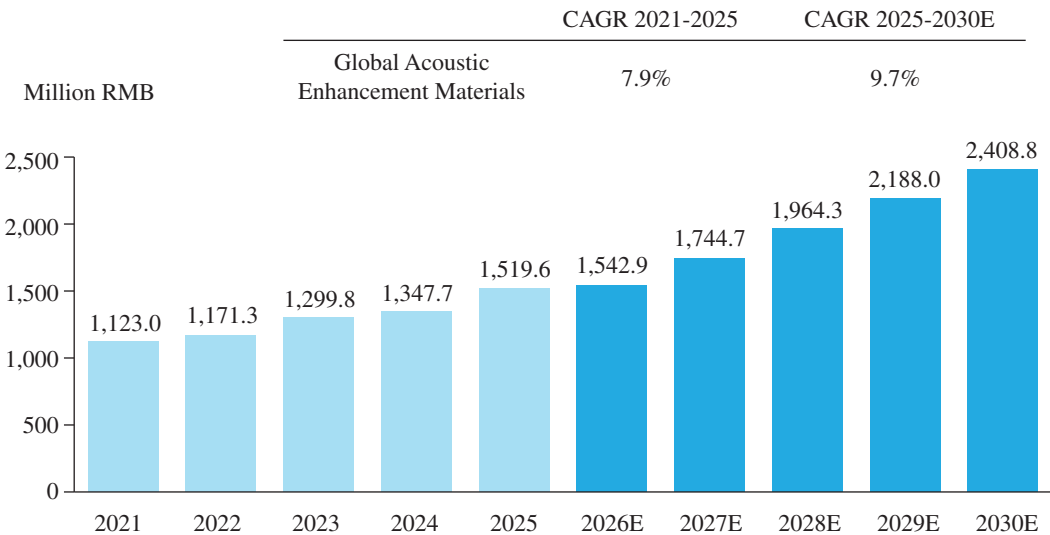
In 2026, global consumer electronics shipments are projected to decline, primarily driven by substantial price increases in memory products. Although there are no significant changes to China’s national subsidy policy in 2026, global shipments of Android smartphones are projected to decline from 1,012.5 million units in 2025 to 904.5 million units in 2026, representing a year-on-year drop of 10.7% partly reflecting higher prices of memory products and resulting cost pressures. Global shipments of Android smartphones are expected to rebound to 964.1 million units in 2027, representing a year-on-year increase of 6.6%, aligning with the restoration of supply and demand balance within the memory product market and the subsequent recovery of the overall consumer electronics market. Concurrently, the consumer electronics sector exhibits cyclical development characteristics, influenced by the innovation of new product categories and the dynamics of the existing market. Supported by increasing adoption of AI products and continued market recovery, shipments of consumer electronics are forecast to record steady growth from 2027 through 2030.

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In the high-end (retail price $\geq$ US\$600) and upper mid-end ($\text{US\$400} \leq \text{retail price} < \text{US\$600}$) smartphone sectors, global shipments are showing steady growth trend, projected to reach 803.6 million units by 2030. By then, high-end and upper mid-end models are expected to account for 57.2% of total smartphone shipments. This growth is primarily driven by market trends such as AI feature upgrades and the optimization of imaging and audio experiences, which are propelling sustained consumer demand for high-performance smart devices. As a new product type, foldable smartphones are witnessing significant shipment growth, increasing from 7.1 million units in 2021 to 26.2 million units in 2025, and are projected to reach 73.2 million units by 2030.

Benefiting from the steady growth of end markets and the upgraded demand for high performance, acoustic technological development therefore places greater emphasis on precision, immersion, and dynamic balance. The global market size of the acoustic enhancement material industry grew from RMB1,123.0 million in 2021 to RMB1,519.6 million in 2025, with a CAGR of 7.9%. It is projected that by 2030, the market size will further grow to RMB2,408.8 million, achieving a CAGR of 9.7% from 2025 to 2030.

Market Size of Global Acoustic Enhancement Materials Industry, 2021-2030E



Source: Acoustical Society of China, European Acoustics Association, Frost & Sullivan interview with industry experts, Frost & Sullivan

Market Driver Analysis of Global Acoustic Enhancement Materials Industry

AI Wave Driving Increasing Demand for Audio Quality Across Diverse Smart Terminals

As AI technology reshapes the landscape of consumer electronics industry, product sound quality has evolved from a basic auxiliary feature to a core element that defines product differentiation and optimizes user experience. Notably, core applications like sound-adsorbing particles are gradually shifting from being exclusive to high-end smartphones to becoming universal in upper mid-end models; upper mid-end smartphone shipments reached 315.3 million units in 2025, accounting for 25.0% of the total, with this share projected to rise to 26.4% by 2030, thereby driving huge market potential. To meet these high-performance demands while aligning with industrial design trends favoring thinner devices and multi-speaker configurations, the utilization rate of acoustic enhancement materials continues to rise, directly determining the output efficiency, distortion levels, and frequency response range of speaker units. Thus, AI technology empowers the coverage of acoustic enhancement materials, enabling the expansion of diverse smart terminals.

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Industry Standard Establishment and Policy Support Promoting Domestic Substitution

Driven by market demand and the strategic push for the localisation of supply chain by Chinese manufacturers and enterprises, industry-leading enterprises have spearheaded the formulation of industry technical standards, such as “Porous Sound-Adsorbing Particles for Micro-Speakers”, thereby taking the lead in surpassing foreign products at the technical specification level. These enterprises have built comprehensive industrialization closed-loop covering basic research and development, process synergy, and rapid commercial product implementation, achieving a successful transformation of acoustic enhancement materials from research and development to final industrial application. Thus, by aligning with national industrial policy guidance in fields like advanced materials and intelligent manufacturing, domestic enterprises have realized localisation across all stages of the acoustic enhancement material sector.

Fundamental Materials Technology Platform Propelling Innovation and Application of Acoustic Enhancement Materials Technology

Relying on the application of diverse and high-quality materials, leading enterprises must possess capabilities in the precision design of fundamental materials, flexible formulation customization, and multi-functional material compositing, thereby enabling the development of targeted acoustic enhancement materials and ensuring customer stickiness. Specifically for sound-adsorbing particles, enterprises need not only to precisely control powder particle size, morphology, and pore structure to regulate sound wave transmission, absorption, and other properties, but also to rapidly formulate new product systems based on specific customer acoustic metrics, device structures, and cost requirements. This continuous effort pushes the performance boundaries and application scenarios of acoustic enhancement materials.

Development Trend Analysis of Global Acoustic Enhancement Materials Industry

AI Smart Terminals and Foldable Screens Enhancing Material Penetration

AI capabilities are currently driving the replacement of consumer electronics smart terminals. Specifically, as AI smartphones become increasingly thin and light, the physical space for the speaker rear cavity is severely squeezed, leading to compromised sound quality, particularly in low-frequency performance. It is expected that products with on-device AI capabilities will become the core category for future market growth. Global AI smartphone shipments are projected to grow from 379.5 million units in 2025 to 1,184.3 million units in 2030, with a CAGR of 25.6%. Global AI PC shipments are projected to grow from 67.6 million units in 2025 to 211.8 million units in 2030, with a CAGR of 25.7%. In addition, global foldable smartphone shipments are expected to increase from 26.2 million units in 2025 to 73.2 million units in 2030, with a CAGR of 22.8%. Within this sector, the increase in the number of micro-speakers per foldable smartphone drives up the usage of acoustic enhancement materials, creating incremental market growth. Typically, the usage volume of sound-adsorbing particles in a single foldable smartphone is significantly higher than that in a traditional smartphone. AI smartphones, AI PCs, and foldable smartphones are expected to lead a new growth cycle for acoustic enhancement materials.

Emerging Scenarios Expanding Acoustic Enhancement Materials Applications

In terms of vertical deepening, sound-adsorbing particles have been successfully applied to the vast majority of high-end smartphones. The future trend involves penetrating into more upper mid-end smartphones by launching products that balance performance and cost to meet the needs of different price segments. In terms of horizontal expansion, AI glasses/XR devices, tablets, and laptops have formed new growth opportunities. With AI glasses/XR devices pursuing immersive auditory interaction, tablets enhancing audio interactive entertainment attributes, and laptops advancing towards high-end and lightweight designs, these emerging smart terminal categories jointly build a new growth trend for industry development. Among these, core categories are in the early stages of their commercialization cycle; global shipments of AI glasses/XR devices are

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projected to grow from 14.5 million units in 2025 to 81.7 million units in 2030, with a CAGR of 41.3%. Leading enterprises are committed to providing comprehensive acoustic enhancement solutions in the future, including cavity design, driving capability upgrades and achieving full coverage across multiple categories in both vertical and horizontal markets.

Technological Innovation Formulating Integrated Acoustic Solutions

Sound-adsorbing particles will continue to advance in terms of elemental composition, particle size control, and reliability verification. Other acoustic diaphragm functional enhancement materials will continue to make breakthroughs in diaphragm functionality and composite properties. In the future, advancements in acoustic enhancement material technology are expected to improve signal-to-noise ratio and sensitivity, achieving a wider frequency response, and enhancing product reliability. Acoustic enhancement materials will transit from the role of providing a single function to becoming the core of building integrated and intelligent acoustic solutions, ultimately delivering an end-to-end, immersive, and high-quality audio experience for users.

Entry Barrier Analysis of Global Acoustic Enhancement Materials Industry

Technical and Process Engineering Barrier

The synthesis process of acoustic enhancement materials involves complex chemical processes, which significantly influence the design of the powder and membrane production workflow. Any minor deviation can affect the material’s acoustic properties, thereby directly impacting the sound quality performance of the terminal speakers.

Customer Accessibility Barrier

Leading enterprises have established standards for long-term business partnerships and technical collaborations, creating stable framework for upstream and downstream of industry value chain, thus ensuring the performance stability and reliability of acoustic enhancement materials, empowering downstream partners and creating value for terminal integrators. They provide highly customized solutions tailored to the device structures and acoustic requirements of different clients, achieving a precise match between products and downstream customers.

Research and Development Barrier

Research and development teams of industry-leading enterprises typically possess interdisciplinary backgrounds spanning acoustics, electronics, and materials science, enabling them to precisely align microscopic material properties with the acoustic performance of end products. These teams possess extensive application experience and strong client communication capabilities, allowing them to rapidly adjust solutions during the design phase to meet end-product requirements.

Competitive Landscape Analysis of Global Acoustic Enhancement Materials Industry

The competitive landscape of the global acoustic enhancement material industry is relatively concentrated. In 2025, the global acoustic enhancement material market size reached RMB1,519.6 million in terms of revenue, with the top five acoustic enhancement material suppliers collectively accounting for 69.2% of the market share. Among them, the Company ranked first globally with a revenue of RMB303.5 million, capturing approximately 20.0% of the global market share.

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Top 5 Global Acoustic Enhancement Materials Providers by Revenue, 2025

Ranking	Company	Revenue (Million RMB)	Market share (%)
1	The Company	303.5	20.0%
2	Company A	226.8	14.9%
3	Company B	200.0	13.2%
4	Company C	170.0	11.2%
5	Company D	150.0	9.9%
Total		1,050.3	69.2%

Source: Disclosure from Annual Reports of Listed Enterprises, Frost & Sullivan interview with industry experts, Frost & Sullivan

Notes:

1. This ranking excludes acoustic enhancement materials produced in-house by consumer electronics smart terminals' brands.
2. Company A was established in 1995 and is headquartered in China. It is listed on the Shanghai Stock Exchange and is primarily engaged in the research, development, production, and sales of polymer microporous materials and functional venting components, with applications in automotive, consumer electronics, new energy, and industrial equipment.
3. Company B was established in 1993 and is headquartered in United Kingdom. It is listed on the London Stock Exchange and is primarily engaged in the research, development, production, and sales of high-performance thermoplastic polymers, including acoustic enhancement material with a core focus on polyether ether ketone and related material solutions.
4. Company C was established in 1926 and is headquartered in Japan. It is listed on the Tokyo Stock Exchange and is primarily engaged in the research, development, manufacturing, and sales of advanced materials, including fibers and textiles, performance chemicals, acoustic enhancement material, carbon fiber composite materials, and electronics-related materials.
5. Company D was established in 1931 and is headquartered in United States. It is listed on the New York Stock Exchange and is primarily engaged in the development, manufacturing, and distribution of advanced engineered materials, including beryllium-based materials for acoustic use, precision optics, specialty alloys, and advanced coatings.

OVERVIEW OF GLOBAL ELECTRONIC CERAMIC POWDERS INDUSTRY

Definition, Classification and Application Scenarios of Electronic Ceramic Powders

Electronic ceramic powders primarily refer to inorganic non-metallic fine powders that are precisely designed and prepared for the manufacturing of electronic ceramic components and parts. Common types of electronic ceramic powders include aluminum oxide, zirconium oxide, silicon nitride, boron nitride, etc., among which core electronic ceramic powders can be widely applied in ceramic coating materials for lithium-ion battery (LIB) separators, cathode material additives, polishing powders for semiconductor manufacturing, precision electronic ceramic powders for semiconductor equipment, fillers for epoxy molding compounds used in advanced packaging, fillers for M7 and above high-speed high-frequency CCLs, and other powders (including applications for solid oxide fuel cell (SOFC) and ceramic substrates), etc.

For electronic ceramic powders and sound-adsorbing particles, they are both classified as inorganic materials, exhibiting similarities in their manufacturing processes and micro-characters with shared underlying technology. Both types of materials involve certain inorganic powder processing capabilities, such as synthesis, milling, and classification. Such commonalities can provide a foundation for technical synergy. Thus, integrated technology platform enables leading participants among inorganic acoustic enhancement materials industry to deeply understand electronic ceramic powders industry.

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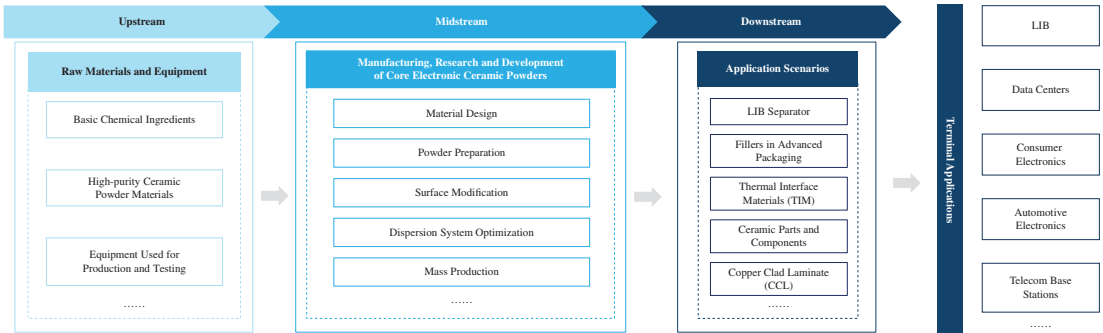
LIB separator ceramic coating materials refer to the slurry of functional materials, or the coating formed after drying, that is covered onto the surface of LIB separators through precision coating technology. Cathode material additives are functional auxiliary materials used to improve the interface properties and structural stability of LIB cathode materials.

Electronic ceramic powders have diversified value-added application scenarios, in advanced packaging, computing power materials and other semiconductor-related sectors. For the semiconductor industry, as semiconductor nodes advance, the number of polishing steps multiplies, requiring advanced powders for defect-free planarization. Simultaneously, the rigorous etching and deposition environments for these advanced chips boost the need for durable precision ceramic components in semiconductor equipment. For the advanced packaging and computing power materials sector, the shift to advanced packaging demands high-performance EMC fillers to manage thermal conductivity, while AI servers require M7+ grade CCL fillers to ensure low signal loss at ultra-high frequencies. Thus, high-end electronic ceramic powder materials such as alumina and silica hold immense growth potential in high-end product segments in the future.

Value Chain Analysis of Electronic Ceramic Powders Industry

The upstream sector of the electronic ceramic powders industry value chain consists of the supply of basic raw materials and equipment relied upon for production. Core raw material encompass different types of basic chemical ingredients and high-purity non-metal materials, as well as precision equipment used for powder preparation, dispersion, and testing. The midstream represents the core segment of the industry chain, mainly covering the manufacturing and research and development of electronic ceramic powders; this involves the entire process of material design, powder preparation, surface modification, dispersion system optimization, and mass production process development. Leading enterprises master the core preparation technologies for electronic ceramic powders, establishing significant advantages in stability and batch consistency. The downstream sector comprises the products and application fields of electronic ceramic powders, primarily covering LIB separator, fillers in advanced packaging, thermal interface materials (TIM), ceramic parts and components, copper clad laminate (CCL), and other semiconductor-related application fields.

Value Chain Analysis of Electronic Ceramic Powders Industry



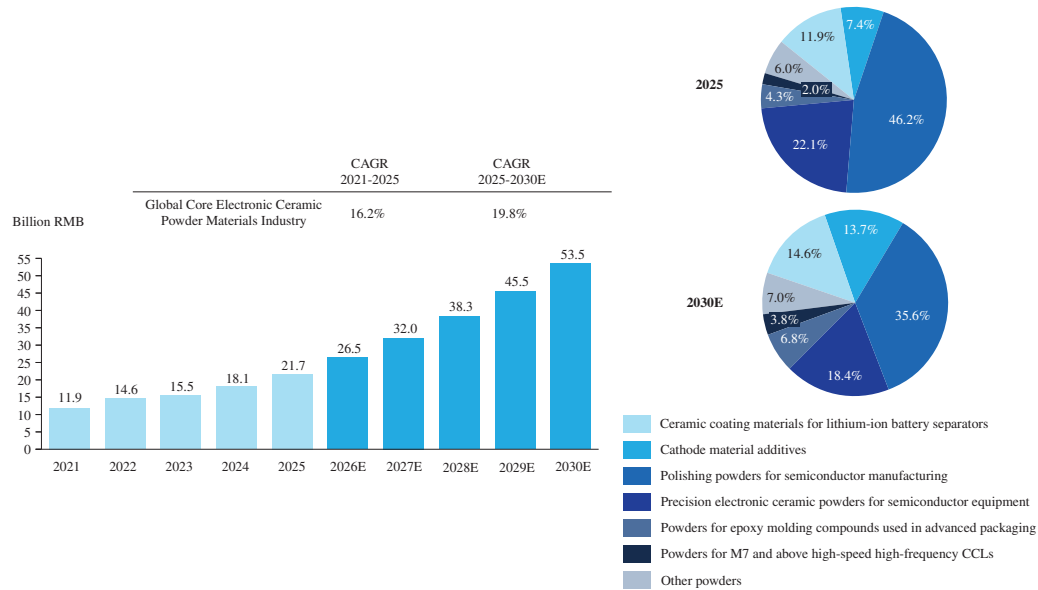
Source: China Electronic Components Association, Frost & Sullivan

Market Size Analysis of Global Electronic Ceramic Powders and LIB Separator Ceramic Coating Materials Industry

The global core electronic ceramic powder market size grew from RMB11.9 billion in 2021 to RMB21.7 billion in 2025, achieving a CAGR of 16.2%. With the continuous penetration and surging demand in downstream sectors such as new energy, semiconductors, and data centers, the increasing demand for high-purity and high-performance powders will rapidly drive the expansion of the core electronic ceramic powder market. By 2030, the market size of global core electronic ceramic powder is projected to reach RMB53.5 billion, with a CAGR of 19.8% from 2025 to 2030.

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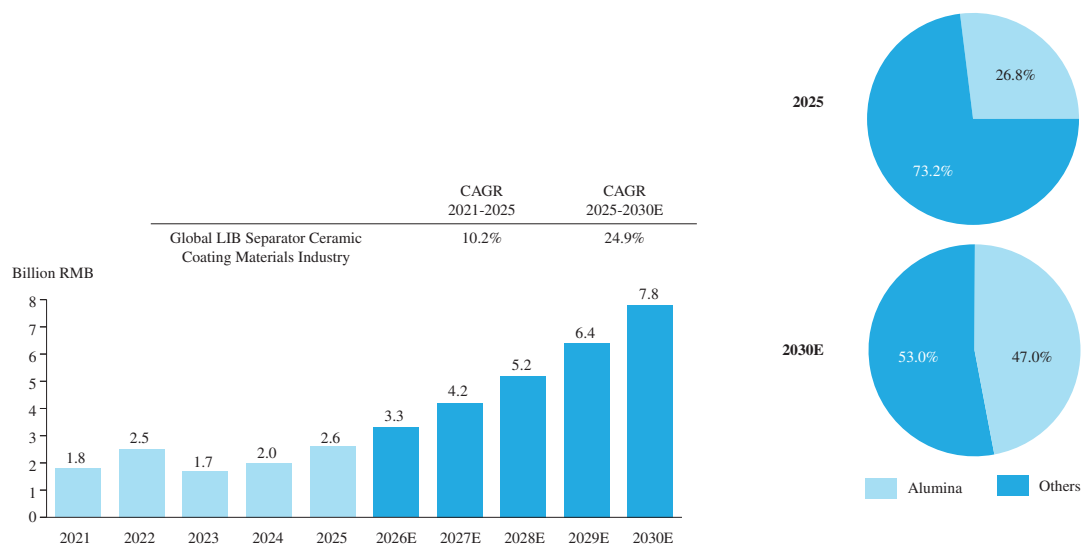
Market Size of Global Core Electronic Ceramic Powder Materials Industry, Classified by Product Types, 2021-2030E



Source: China Electronic Components Association, Frost & Sullivan

The market size of global LIB separator ceramic coating materials grew from RMB1.8 billion in 2021 to RMB2.6 billion in 2025, with a CAGR of 10.2%. With the continuously increasing penetration of high-performance separators in NEVs and energy storage systems, the global market size is projected to reach RMB7.8 billion by 2030, reflecting a CAGR of 24.9% from 2025 to 2030. Notably, leveraging its high thermal stability and excellent particle conductivity, alumina will expand with its share increasing from 26.8% in 2025 to 47.0% in 2030.

Market Size of Global LIB Separator Ceramic Coating Materials Industry, 2021-2030E



Source: Frost & Sullivan interview with industry experts, Frost & Sullivan

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Market Driver Analysis of Global Electronic Ceramic Powders Industry

Domestic Substitution Broadening Value Chain of Electronic Ceramic Powders in China

As China accelerates the localization of electronic ceramic powders, competition is shifting to advanced technologies and vertical integration of industries, empowering enterprises to expand from single sector to diversified application scenarios. This macro trend is fundamentally underpinned by the localisation of supply chain by Chinese manufacturers and enterprises, which ensures greater resilience and cost-efficiency in sourcing critical upstream raw materials. In particular, the localization rate in sectors such as advanced packaging, computing power materials, and other semiconductor-related application fields is rising rapidly, enabling Chinese manufacturers to achieve domestic substitution in the field of high-end electronic ceramic powders. Furthermore, by establishing mature domestic production ecosystems, these enterprises are increasingly capable of meeting the stringent purity, nano-scale consistency, and formulation requirements. Such continuous technological breakthroughs not only mitigate external supply risks but also solidify the material foundation for next-generation industrial use.

Higher LIB Safety Level Requirement Demanding Inorganic Material Coating

Pursuit of higher energy density and faster charging in LIB is creating a structural surge in demand for inorganic ceramic coatings, particularly alumina. By significantly enhancing thermal stability and puncture resistance, these coating materials mitigate critical risks such as shrinkage and internal short circuits. Therefore, alumina ceramic materials in the LIB separator coating sector satisfy the need for reaching higher LIB safety level, boosting the growth of electronic ceramic powders in this industry. This reliance is set to deepen with advancements in coating uniformity and the emergence of semi-solid and solid-state battery technologies.

High-Performance Scenarios Guiding the Integration of the Ceramic Material Supply Chain

The demand for high-performance electronic ceramics is driving a paradigm shift from transactional supply to collaborative research and development. In key sectors like LIBs and semiconductors, upstream powder suppliers are now integral to the design process, ensuring material consistency and rapid adaptation to evolving technologies. Through this model of vertical integration and embedded collaboration, market leaders have established an integrated supply chain that delivers precise, customized solutions for complex application scenarios.

Development Trend Analysis of Global Electronic Ceramic Powders Industry

Rapid Development Momentum in LIB and Semiconductor Industries Expanding Market Space

Global shipments of power (mainly NEV) and energy storage LIB are expected to surge from 1,495.0GWh and 419.7GWh in 2025 to 3,766.5GWh and 1,545.3GWh in 2030, with CAGR reaching 20.3% and 29.8% respectively. Continuous future requirements for higher energy density, safety, and cycle life are driving a sustained surge in the market for electronic ceramic powder materials. At the same time, the application of electronic ceramic powders in the pan-semiconductor field is witnessing explosive growth. For computing power specifically, by 2030, global AI computing power demand is projected to reach nearly 900 ZFLOPS, nearly 20 times that of 2025. As semiconductor manufacturing processes advance to higher levels, high-end electronic ceramic powders, relying on their excellent physicochemical performance indicators, will see rapid market penetration in the future.

Advanced Semiconductor Nodes Accelerating Penetration of Advanced Electronic Ceramic Powders

Advanced semiconductor nodes are driving the deeper integration of alumina and silicon-based ceramic powders into advanced semiconductor equipment. Characterized by high temperatures, intense plasma, and corrosive environments, extreme processing conditions necessitate superior material resilience, specifically regarding thermal shock, dielectric stability, and corrosion resistance. As technical specifications become increasingly stringent, supplier selection is pivoting toward those with deep technological expertise and process adaptability.

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Closed-Loop Solutions Aligning with Downstream Customer Needs

As downstream markets prioritize performance and customization, electronic ceramic providers are evolving into closed-loop solution providers. To meet with customers’ needs, companies must leverage comprehensive technology platforms to deliver tailored material solutions that precisely align with evolving client requirements through collaborative design and verification.

Entry Barrier Analysis of Global Electronic Ceramic Powders Industry

Process Efficiency Barrier

The production of electronic ceramic powders spans the entire process from raw material selections, powder design and slurry dispersion to precision coating. As downstream applications demand greater coating thinness, uniformity, and reliability, the required process precision for electronic ceramic powders continues to rise, creating significant process barriers for new entrants.

Customer Qualification Barrier

Product introduction requires undergoing strict testing and multiple rounds of evaluation lasting several years to comprehensively verify the material’s performance and reliability during long-term battery cycling before it can finally enter the core supply chain lists of top-tier manufacturers. Leading enterprises more easily secure recognition from core customers due to their long-term accumulation and stable quality.

Research and Development Platform Barrier

Electronic ceramic powder materials require the formation of an integrated research and development closed loop encompassing powder design, formulation synthesis, process implementation, and application testing. Enterprises possessing platform capabilities can rapidly verify new materials, shorten the path from laboratory to mass production, and continuously iterate product performance, thereby building a comprehensive technical moat.

Competitive Landscape Analysis of Global LIB Separator Ceramic Coating Materials Alumina Industry

The global alumina ceramic materials market in LIB separator coating sector is highly concentrated, with significant dominance by top players. In 2025, the top five enterprises by revenue accounted for a combined market share of approximately 78.0%. Among them, the Company holds a significant leading advantage, ranking second in the industry with a global market share of 14.3%.

Top 5 Global Alumina Ceramic Materials Providers in LIB Separator Coating Sector by Revenue, 2025

Ranking	Company	Revenue (Million RMB)	Market share (%)
1	Company E	215.0	31.2%
2	The Company	98.6	14.3%
3	Company F	90.0	13.0%
4	Company G	70.0	10.1%
5	Company H	65.0	9.4%
Total		538.6	78.0%

Source: Disclosure from Annual Reports of Listed Enterprises, Frost & Sullivan interview with industry experts, Frost & Sullivan

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Notes:

1. Company E was established in 2005 and is headquartered in China. It is listed on the Shenzhen Stock Exchange and is primarily engaged in the research, development, and production of functional ceramic materials, including electronic materials, catalytic materials, biomedical materials, new energy enhancement materials, structural ceramics, architectural ceramics, and environmental materials.
2. Company F was established in 2014 and is headquartered in China. Its parent company is listed on the Shanghai Stock Exchange. Part of its business specializes in the application of alumina in LIB separator ceramic coating materials.
3. Company G was established in 2000 and is headquartered in China. It is listed on the Beijing Stock Exchange and is specialized in the research and development, production, and sales of high-end alumina powders. Its products are applied in LIB separator, electronic ceramic materials, and other fields.
4. Company H was established in 2003 and is headquartered in China. It is a privately held company. Its core business covers the research and development, production, and sales of advanced aluminum-based inorganic non-metallic materials.

OVERVIEW OF GLOBAL ELECTRONIC ADHESIVES INDUSTRY

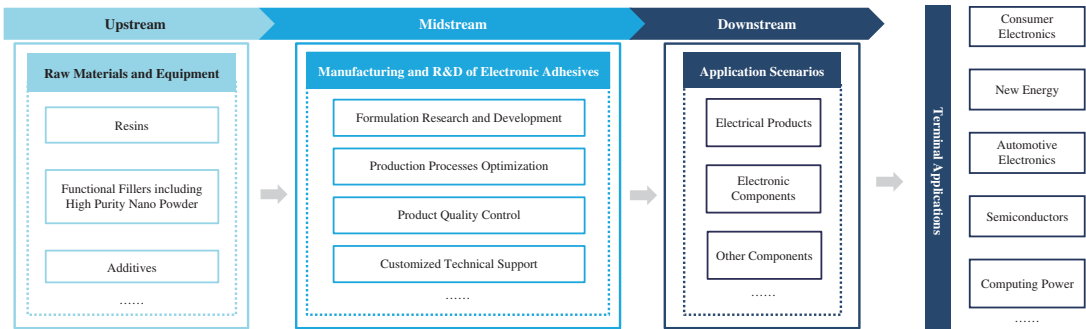
Definition, Classification and Application Scenarios of Electronic Adhesives

Electronic adhesives refer to precision adhesives specifically designed for electronic and electrical products to perform specific functions such as bonding, sealing, thermal conductivity, electrical conductivity, insulation, and protection. Specialty adhesives require specialized high-purity powder as the basis to achieve specific functionalities. Electronic adhesives are primarily categorized into acoustic applications, optical applications, module assembly applications, NEVs, advanced packaging, computing power and other semiconductor-related applications. Among these, acoustic adhesives are important for speaker box reliability, sound quality, and life span, thereby ensuring and enhancing the clarity and fullness of sound transmission.

Value Chain Analysis of Electronic Adhesives Industry

The upstream sector of the electronic adhesives industry value chain is based on core raw materials, encompassing resins, additives, and functional fillers with distinct physical properties which include high purity nano-powder. The midstream segment primarily covers the research and development and manufacturing of adhesives. Enterprises in this segment typically regard formulation research and development capabilities, surface treatment and curing technology as their core competency, focusing on product performance optimization and adaptability to specific application scenarios. The downstream application landscape is extensive, covering a diverse range of electronic and electrical products such as consumer electronics, new energy, automotive electronics, semiconductors, computing power, and industrial and communications sectors.

Value Chain Analysis of Electronic Adhesives Industry



Source: China Adhesives and Tape Industry Association, Frost & Sullivan

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Market Size Analysis of Global Electronic Adhesives and Acoustic Adhesives Industry

Benefiting from continuous upgrades in the global electronics industry and the diversification of end-use applications, the global electronic adhesives industry has experienced stable growth, with its market size expanding from RMB34.8 billion in 2021 to RMB41.0 billion in 2025, representing a CAGR of 4.2%. Looking ahead, driven by the sustained development of key sectors such as semiconductors and new energy, along with rising performance standards for adhesives in consumer electronics, the market size is projected to reach RMB55.4 billion by 2030, reflecting a CAGR of approximately 6.2% from 2025 to 2030.

Driven by upgrades in consumer electronics acoustic performance and the unleashing of demand for smart wearables, the acoustic adhesives market has witnessed rapid growth with the market size expanding from RMB400.3 million in 2021 to RMB545.2 million in 2025, representing a CAGR of 8.0% during this period. Looking ahead, propelled by the integration of AI technology and further diversification of smart terminal forms, requirements for product acoustic performance will intensify, accelerating the release of demand for acoustic adhesives. By 2030, the market size is projected to reach RMB786.2 million, with a CAGR of approximately 7.6% from 2025 to 2030.

Market Driver and Development Trend Analysis of Global Electronic Adhesives Industry

Evolution of Electronic Products Enabling Innovation in High-Performance Adhesives

The continuous development of electronics products such as smartphones and smart wearables towards thinner, lighter, and higher-performance designs has placed higher demands on fields including acoustics, thermal management, electromagnetic shielding, and sealing. In advanced iterative application scenarios, the requirements for purity, reliability, and precision of adhesives are extremely high, becoming the key driver for growth in the high-performance electronic adhesives market.

Formulations of Various Inorganic materials and Resins Enabling Diverse End-Use Applications

Driven by continuous innovation in adhesives industry, products are evolving towards functional composite formulations combining inorganic materials and resins to deliver customized patterns. This shift is accelerating their penetration into high-precision industries such as consumer electronics, semiconductors, new energy, etc. Simultaneously, this evolution optimizes performance in diverse scenarios like acoustics and advanced packaging, thereby expanding the overall market space.

Innovation in Adhesives Materials and Refinement of Precision Manufacturing Systems

Continuous material innovation ensures that acoustic adhesives exhibit excellent chemical stability, bonding strength, and other physical properties after curing. Furthermore, with the miniaturization of electronic products, higher-precision automation equipment imposes stricter requirements on the viscosity and rheology of electronic adhesives, guiding the construction and refinement of precision manufacturing systems.

Entry Barrier Analysis of Global Electronic Adhesives Industry

The barriers to entry for new entrants in the global electronic adhesives industry primarily lie in patented technology, customer accessibility, and market channels. Core technologies and formulations within the industry are safeguarded by strict patent networks established by major incumbents, presenting high research and development thresholds for new entrants; downstream electronics manufacturing customers impose rigorous and protracted qualification processes on suppliers, and once qualified, stable supply chain relationships are established, creating strong

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customer stickiness. Furthermore, mature global channel networks and the capability to provide on-site technical services have become industry standards, meaning new competitors lacking established channels and brand reputation struggle to build an effective market system in the short term.

Competitive Landscape Analysis of Global Acoustic Adhesives Industry

As a niche segment of electronic adhesives characterized by strong functionality and high technical barriers, acoustic adhesives are gradually exhibiting a differentiated competitive landscape. In 2025, the top five enterprises by revenue accounted for a combined market share of approximately 68.4%, reflecting a highly concentrated market. Against this backdrop, leveraging continuous investment and technological accumulation in specialized acoustic adhesives, the Company has maintained the trend of powder-adhesive correlation in acoustic applications and driven the domestic substitution of acoustic adhesives, ranking fourth globally with a 3.2% global market share.

Top 5 Global Acoustic Adhesives Providers by Revenue, 2025

Ranking	Company	Revenue (Million RMB)	Market share (%)
1	Company I	200.0	36.7%
2	Company J	110.0	20.2%
3	Company K	35.0	6.4%
4	The Company	17.7	3.2%
5	Company L	10.0	1.8%
Total		372.7	68.4%

Source: Frost & Sullivan interview with industry experts, Frost & Sullivan

Notes:

1. Company I was established in 1961 and is headquartered in Germany. It is a privately owned specialist in high-performance acoustic and consumer adhesives, focusing on the development, manufacturing, and application of high-tech adhesives solutions.
2. Company J was established in 1876 and is headquartered in Germany. It is listed on the Frankfurt Stock Exchange and is primarily engaged in the development, manufacturing, and marketing of branded consumer goods and industrial solutions, with core businesses spanning adhesives technologies, and other products.
3. Company K was established in 1902 and is headquartered in the United States. It is listed on the New York Stock Exchange and is primarily engaged in research, development, and manufacturing of advanced material science solutions, with offerings for the consumer electronics industry including adhesives for acoustic solutions.
4. Company L was established in 1948 and is headquartered in Japan. Its parent company is listed on the Tokyo Stock Exchange and is primarily engaged in the development, manufacturing, and marketing of industrial and consumer adhesives products, with core offerings covering industrial adhesives, construction adhesives, etc.

OVERVIEW OF GLOBAL ENERGY ENHANCEMENT MATERIALS INDUSTRY

Definition and Classification of Energy Enhancement Materials

Energy enhancement materials are defined as specialized functional materials designed to optimize the energy conversion efficiency and operational stability of power generation systems, with their primary application currently concentrated in the new energy sector including photovoltaic (PV), wind power, etc. Core energy enhancement materials products include PV back-glass coating materials, PV conductive paste, etc.

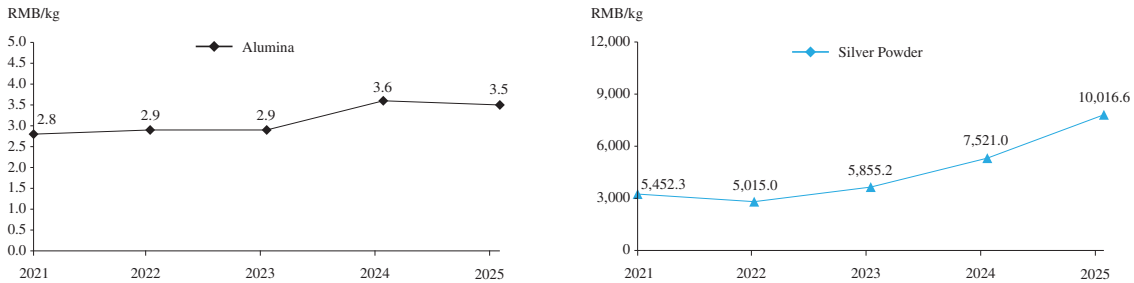
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While the broader energy enhancement material market is currently grappling with structural overcapacity and intense market competition, the industry is undergoing a critical phase of product structure adjustment. As the market pivots from quantity expansion to quality expansion, advanced energy enhancement materials are poised to re-emerge as the central driver of market development, underpinning the next generation of new energy technologies.

RAW MATERIAL PRICE ANALYSIS AND PREDICTION

Fluctuations in raw material prices have a significant impact on cost control within the industry chain. Volatility and unit value of raw materials for acoustic enhancement materials, electronic ceramic powders and electronic adhesives are relatively low compared to that of energy enhancement materials, specially for silver powder. Alumina’s average market price has gradually risen from RMB2.8 per kg in 2021 to RMB3.5 per kg in 2025. Silver powder prices are highly correlated with international silver prices. Its average market price rose from RMB5,452.3 per kg in 2021 to RMB10,016.6 per kg in 2025. For the six months ended June 30, 2026, driven primarily by supply and demand dynamics, macroeconomic conditions, and geopolitical factors, the global average selling price of silver powder increased to RMB20,380.7 per kg.

Alumina and Silver Powder Price Analysis in China, from 2021 to 2025



Source: Shanghai Futures Exchange, Frost & Sullivan