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Global Semi-solid Battery CAM Supply, Demand and Key Producers, 2026-2032

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Abstracts

The global Semi-solid Battery CAM market size is expected to reach $ 1057 million by 2032, rising at a market growth of 62.8% CAGR during the forecast period (2026-2032).

Semi-solid Battery Cathode Active Material, or Semi-solid Battery CAM, refers to the electrochemically active powder used in the positive electrode of a rechargeable semi-solid lithium battery. It stores and releases electrical energy through reversible lithium-ion intercalation and deintercalation, redox reactions, or other reversible electrochemical processes during charging and discharging.

A semi-solid battery contains both a solid-electrolyte phase and a limited amount of liquid or gel electrolyte. Consequently, its CAM must provide not only suitable specific capacity, operating voltage, rate capability and cycle life, but also strong compatibility with solid electrolytes, low interfacial resistance, limited parasitic reactions, and adequate mechanical and thermal stability. Adaptation technologies may include elemental doping, single-crystal particle design, concentration-gradient structures, residual-lithium control, and functional coatings based on oxides, phosphates, borates, polymers or solid-electrolyte materials.

Key Findings

Nickel-based layered oxides represented the largest chemistry segment, supported by premium electric-vehicle and aviation energy-density requirements

Electric road vehicles formed the largest application, while drones, eVTOL aircraft and robotics generated faster premium-material qualification demand

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Single-crystal, composite-morphology and ion-conducting coated materials gained importance as suppliers addressed cracking and interfacial resistance

Market Trends

Semi-solid Battery CAM is evolving from the adaptation of conventional lithium-ion cathode grades toward materials designed jointly with the electrolyte, electrode and cell process. The principal development direction is no longer limited to increasing capacity; suppliers are coordinating particle morphology, bulk doping, surface chemistry, mechanical response and ion-transport pathways. Single-crystal and quasi-single-crystal products are gaining attention because lower grain-boundary density can reduce intergranular cracking and gas generation, while optimized polycrystalline materials remain competitive where rate performance, manufacturing yield and cost are decisive. Mixed-morphology and structurally reinforced particles are emerging as an intermediate route that combines the kinetic performance of secondary particles with improved mechanical stability. Surface treatment is progressing from conventional oxide protection toward multilayer, deformable and fast-ion-conducting coatings that improve contact with oxide, sulfide, polymer or composite electrolytes. Nickel-rich NCM and NCMA currently lead high-energy applications, but high-voltage medium-nickel materials, lithium-rich manganese-based materials, high-voltage LCO, LFP and LMFP are increasingly being adapted for applications that prioritize safety, cost or cycle life. Commercialization is also shifting toward jointly developed customer grades, longer qualification programmes and closer integration between CAM suppliers, solid-electrolyte developers and battery manufacturers.

Market Dynamics

Drivers

The primary market driver is the requirement for batteries offering higher energy density and improved safety without immediately adopting the manufacturing complexity of a completely liquid-free cell. Semi-solid architectures retain a limited liquid or gel phase to improve electrode wetting and ionic contact while using solid-electrolyte components to reduce flammability and support advanced electrode systems. Premium electric vehicles require greater range without a proportional increase in pack weight, while drones, eVTOL aircraft, robots and autonomous industrial equipment place an even

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higher value on gravimetric energy density. The commercialization of semi-solid vehicle batteries and condensed or hybrid-electrolyte platforms has created a practical qualification channel for high-nickel, lithium-rich manganese-based and interface-coated CAM. Demand is further supported by manufacturers seeking a transitional material platform that can be adjusted for both semi-solid and future all-solid-state batteries. The movement of several Chinese suppliers from laboratory development to tonne-scale, thousand-tonne-scale or batch supply indicates that the market is entering an early industrialization phase rather than remaining exclusively at the research-cell stage.

Restraints

Market expansion is restrained by the small number of semi-solid battery programmes operating at stable commercial volumes and by the absence of a standardized electrolyte architecture. Materials qualified with oxide, sulfide, polymer or hybrid electrolytes can exhibit substantially different interfacial behaviour, limiting direct transfer between customers. CAM suppliers must therefore conduct extended testing for coating compatibility, residual moisture, gas generation, high-voltage stability, electrode processing and long-term storage. Additional surface treatment, secondary heat processing and stringent environmental control raise conversion costs, while early production lines frequently operate below the yield and utilization rates achieved by conventional NCM, LCO or LFP products. Semi-solid cell performance also depends on the complete electrode formulation, electrolyte distribution, separator architecture and cell pressure, meaning that improvements in CAM alone may not translate into equivalent gains at cell or pack level. The addressable market is further limited by competition from mature liquid-electrolyte lithium-ion batteries, whose safety, fast-charging and energy-density performance continues to improve while benefiting from much larger production scale.

Opportunities

The strongest opportunity is the development of modular CAM platforms that can be tailored to different solid–liquid ratios and electrolyte chemistries through changes in coating composition, particle structure and electrode formulation. High-nickel NCM and NCMA remain attractive for premium vehicles and aviation, while high-voltage medium-nickel materials can provide a more balanced combination of energy density, safety and raw-material cost. Lithium-rich manganese-based materials offer longer-term potential for cells targeting very high specific energy, whereas LFP and LMFP can expand semi-solid technology into applications that prioritize safety, cycle life and cost. High-voltage

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LCO and engineered small-particle materials create opportunities in consumer electronics, drones and compact robotic systems. Suppliers can also increase their value contribution by providing cathode active material together with solid-electrolyte powders, interface modifiers, electrode-processing support and recycling services. Regional supply-chain localization in Europe, North America and East Asia creates additional openings for companies capable of providing traceable raw materials, lower-carbon manufacturing and customer-specific technical service near battery production sites.

Challenges

The principal technical challenge is maintaining a low-resistance and chemically stable interface throughout repeated charging, discharging and temperature changes. Direct contact between high-voltage cathodes and solid electrolytes can generate resistive decomposition products, while volume changes in active particles can cause contact loss and interrupt ion or electron pathways. Polycrystalline particles may develop internal cracks, but single-crystal products can experience slower lithium transport or require more demanding synthesis and electrode-processing conditions. Protective coatings must be sufficiently complete and chemically stable without becoming too thick or poorly conductive. These requirements become more difficult at commercially relevant cathode loading, density and production speed. Manufacturers must also control particle-size distribution, residual lithium, moisture, coating uniformity, metallic contamination and batch consistency across industrial-scale furnaces. Commercial risks include frequent changes in downstream battery designs, long customer-validation periods and uncertainty over which combinations of oxide, sulfide, polymer and liquid components will dominate. Suppliers investing in a single electrolyte route may therefore face product redesign or underutilized specialized capacity if customer technology roadmaps change.

Industry Chain Analysis

The upstream segment comprises lithium, nickel, cobalt, manganese, iron, phosphorus and other active-material inputs; NCM and NCMA precursors; lithium hydroxide and lithium carbonate; dopants; coating compounds; binders and solid-electrolyte-derived interface materials. Raw-material purity, precursor morphology and metal-ratio consistency directly influence final CAM performance, giving vertically integrated resource and precursor suppliers advantages in quality control, traceability and cost

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management. Midstream manufacturing covers precursor preparation or procurement, lithium mixing, calcination, crushing, classification, washing or non-washing treatment, surface modification, secondary heat treatment and electrochemical quality control. Semi-solid-compatible products add formulation development, electrolyte-contact testing and customer-specific interface validation to this process. Downstream customers include specialized semi-solid battery manufacturers, conventional cell producers developing hybrid-electrolyte platforms, vehicle manufacturers with captive battery programmes and producers of aviation or industrial battery systems. Value creation is concentrated in particle and surface design, production yield, consistency, customer qualification and the ability to match a CAM with a particular solid electrolyte and electrode process. Recycling companies are becoming increasingly relevant because recovered lithium, nickel, cobalt and manganese can reduce raw-material exposure and help battery customers meet carbon-footprint and traceability requirements.

Segment Insights

By cathode chemistry, nickel-based layered oxides form the largest current segment because semi-solid batteries are initially being commercialized in premium applications where specific energy and operating voltage justify additional material and validation costs. This segment includes high-nickel NCM, ultra-high-nickel NCM, NCMA and related layered oxides. High-voltage medium-nickel products are expected to gain importance as customers seek to reduce nickel and cobalt intensity without sacrificing excessive energy density. Cobalt-based layered oxides, particularly high-voltage LCO, occupy a smaller but strategically relevant position in compact batteries for consumer electronics, drones and specialized equipment. Phosphate and polyanion materials, led by LFP and LMFP, provide lower raw-material cost, thermal stability and long cycle life and are therefore better positioned for mainstream mobility, industrial systems and selected stationary applications. Manganese-based materials include spinel LMO, high-voltage LNMO and lithium-rich manganese-based products, with lithium-rich formulations offering a longer-term route toward higher specific capacity.

By particle architecture, the original nano-sized category should be treated cautiously because nanoscale primary particles can also be components of polycrystalline secondary particles and therefore do not form a fully independent market segment. A more commercially robust classification consists of polycrystalline secondary-particle materials, single-crystal and quasi-single-crystal materials, and composite-morphology or other engineered-particle materials. Polycrystalline products retain advantages in

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established manufacturing, capacity utilization and rate capability. Single-crystal and quasi-single-crystal materials are expanding in high-voltage and high-nickel applications where crack suppression and reduced gas generation are priorities. Composite-morphology products combine different particle sizes or structures to balance electrode density, ion transport and mechanical durability. Functional coating should be analysed as a technology dimension rather than a separate chemistry, with conventional protective coatings, composite interface coatings and fast-ion-conducting coatings representing progressively higher levels of electrolyte-specific adaptation.

Downstream Market Opportunities

Electric road vehicles account for the largest current opportunity because premium passenger vehicles and selected commercial vehicles can absorb higher CAM costs in exchange for longer range, lower pack weight and improved safety. Aircraft, drones and eVTOL platforms represent the most attractive premium-growth application because battery mass directly affects payload, endurance and operating range. Consumer electronics and portable power systems provide opportunities for high-voltage LCO, high-nickel layered oxides and engineered small-particle materials, particularly where compact size and runtime are more important than minimum cost. Industrial equipment, humanoid robots and autonomous mobile machines require high power, cycle stability and safe operation in enclosed environments, creating demand for customized high-nickel, manganese-rich or phosphate materials. Marine, rail and off-highway equipment can adopt semi-solid batteries where vibration resistance, thermal safety and reduced maintenance offset higher initial cost. Stationary storage and backup power are likely to remain smaller applications in the near term because conventional LFP systems already offer strong economics, although semi-solid LFP or LMFP may find opportunities in space-constrained, high-safety or harsh-environment projects.

Regional Insights

China is the largest and most commercially advanced regional market, supported by specialist semi-solid battery manufacturers, vehicle demonstration programmes and an extensive domestic CAM supply chain. BASF Shanshan has delivered mass-produced ultra-high-nickel CAM to WELION, Easpring has reported cumulative thousand-tonne shipments of medium-nickel, high-nickel, lithium nickel manganese oxide and LFP materials for solid–liquid batteries, and Xiamen Tungsten New Energy has achieved batch supply of cathode materials using morphology design and deformable fast-ion-

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conductor coatings. Ronbay Technology, BTR and Huayou B&M are expanding solid-state and hybrid solid–liquid material platforms through high-nickel cathodes, integrated material solutions or joint development with battery customers.

South Korea represents a major technology-development and potential scale-up region, supported by EcoPro BM, POSCO Future M, LG Chem and L&F in high-nickel, single-crystal, surface-treatment and solid-state cathode technologies. Japan maintains strong powder-synthesis and automotive qualification capabilities through Sumitomo Metal Mining and other established CAM producers, although much of the disclosed activity is oriented toward future all-solid-state commercialization. Europe is led by BASF and Umicore in advanced CAM, prototype production and customer collaboration, while North American activity is more closely associated with battery developers and automotive qualification programmes than with large independent semi-solid CAM production. Taiwan and Southeast Asia currently play smaller roles in specialized material development, cell manufacturing and future supply-chain localization.

Report Scope

This report studies the global Semi-solid Battery CAM production, demand, key manufacturers, and key regions.

This report is a detailed and comprehensive analysis of the world market for Semi-solid Battery CAM and provides market size (US$ million) and Year-over-Year (YoY) Growth, considering 2025 as the base year. This report explores demand trends and competition, as well as details the characteristics of Semi-solid Battery CAM that contribute to its increasing demand across many markets.

Highlights and key features of the study

Global Semi-solid Battery CAM total production and demand, 2021-2032, (Kilotons)

Global Semi-solid Battery CAM total production value, 2021-2032, (USD Million)

Global Semi-solid Battery CAM production by region & country, production, value, CAGR, 2021-2032, (USD Million) & (Kilotons), (based on production site)

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Global Semi-solid Battery CAM consumption by region & country, CAGR, 2021-2032 & (Kilotons)

U.S. VS China: Semi-solid Battery CAM domestic production, consumption, key domestic manufacturers and share

Global Semi-solid Battery CAM production by manufacturer, production, price, value and market share 2021-2026, (USD Million) & (Kilotons)

Global Semi-solid Battery CAM production by Type, production, value, CAGR, 2021-2032, (USD Million) & (Kilotons)

Global Semi-solid Battery CAM production by Application, production, value, CAGR, 2021-2032, (USD Million) & (Kilotons)

This report profiles key players in the global Semi-solid Battery CAM market based on the following parameters - company overview, production, value, price, gross margin, product portfolio, geographical presence, and key developments. Key companies covered as a part of this study include BASF, Huayou Cobalt, etc.

This report also provides key insights about market drivers, restraints, opportunities, new product launches or approvals.

Stakeholders would have ease in decision-making through various strategy matrices used in analyzing the World Semi-solid Battery CAM market

Detailed Segmentation:

Each section contains quantitative market data including market by value (US$ Millions), volume (production, consumption) & (Kilotons) and average price (US$/Ton) by manufacturer, by Type, and by Application. Data is given for the years 2021-2032 by year with 2025 as the base year, 2026 as the estimate year, and 2027-2032 as the forecast year.

Global Semi-solid Battery CAM Market, By Region:

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United States

China

Europe

Japan

South Korea

ASEAN

India

Rest of World

Market Segmentation

Global Semi-solid Battery CAM Market, Segmentation by Type:

Polycrystalline Secondary-Particle

Single-Crystal and Quasi-Single-Crystal

Nano-sized and Other Engineered-particle

Global Semi-solid Battery CAM Market, Segmentation by Cathode Chemistry:

Nickel-based Layered Oxides

Cobalt-based Layered Oxides

Phosphate and Polyanion Materials

Manganese-based Oxides

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Others

Global Semi-solid Battery CAM Market, Segmentation by Application:

Electric Road Vehicles

Aircraft and Unmanned Aerial Vehicles

Marine, Rail and Off-highway Mobility

Consumer Electronics and Portable Power

Industrial Equipment and Robotics

Stationary Energy Storage and Backup Power

Others

Companies Profiled:

BASF

Huayou Cobalt

Key Questions Answered

1. How big is the global Semi-solid Battery CAM market?
2. What is the demand of the global Semi-solid Battery CAM market?
3. What is the year over year growth of the global Semi-solid Battery CAM market?
4. What is the total value of the global Semi-solid Battery CAM market?
5. Who are the Major Players in the global Semi-solid Battery CAM market?
6. What are the growth factors driving the market demand?

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