

Silicon Anode for Li-ion Batteries

Patent Landscape Analysis – September 2024

Who are the key players and newcomers in the global IP race for the promising silicon anode-based Li-ion batteries?

REPORT OUTLINE

- Silicon Anode Li-ion Batteries
- Patent Landscape Analysis
- September 2024
- PDF >100 slides
- Excel file >18,200 patent families
- Reference: KM24004
- 4,990 EUR for a multi-user license



KEY FEATURES

- **Global patenting trends**, including time evolution of patent publications, countries of patent filings, etc.
- **Main patent assignees and IP newcomers** in the different segments of the supply chain.
- Key players' **IP position** and the relative **strength** of their patent portfolio.
- Patents categorized by **supply chain segments** (materials, anode, battery cell, other battery components).
- **Recent patenting activities** of key players.
- Focus on **startups, pure players, and IP newcomers**.
- **Excel database** containing all patents analyzed in the report, including **patent segmentations** and hyperlinks to an **updated online database**.

RELATED REPORTS & MONITORS

- [Silicon Anode for Li-ion Batteries – Patent Landscape 2022](#)
- [Solid-State Li-ion Batteries with Inorganic Solid Electrolytes - Patent Landscape Report](#)
- [Solid-State Batteries - Patent Monitoring Service \(annual subscription\)](#)

The recognized potential of the silicon-based anode for Li-ion batteries has led to significant investments in bringing this technology to market.

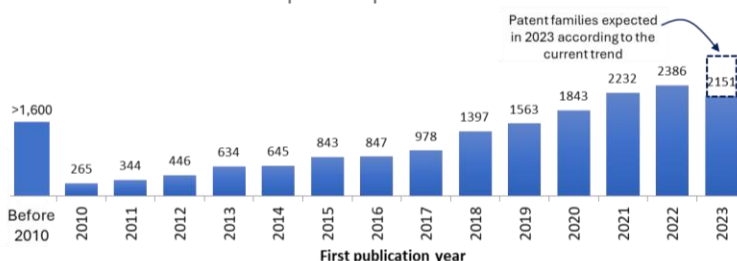
Silicon-based anodes in Li-ion batteries offer superior electrochemical performance, including higher energy density, greater gravimetric and volumetric capacity, suitable thermodynamic lithiation potentials, and higher average voltage.

Today, the use of silicon-based anodes in Li-ion batteries is becoming a reality, with billions of dollars flowing into silicon anode start-ups ([IDTechEx, 2021](#)) and a market for silicon anode material for Li-ion batteries projected to reach \$24 billion by 2034 ([IDTechEx, 2024](#)). Several material manufacturers, such as **Advano, Sila Nanotechnologies, Elkem, Group14, NanoGraf, OneD Materials, and Nexeon**, have announced the commercial production of silicon active materials for Li-ion batteries. Likewise, several battery manufacturers have announced the commercial availability of silicon anode Li-ion cells, including **Amprius, Sionic Energy** (formerly NOHMS), **Farasis Energy, Enovix, StoreDot, Samsung, Panasonic, PPES** (a joint venture between Toyota and Panasonic), **Murata, and Enevate/EnerTech**. In the automotive sector, there have been significant strategic acquisitions and partnerships. **Tesla** acquired battery manufacturer **Maxwell Technologies** in 2019 and battery start-up **SiLion** in 2021. That same year, **PPES and Nexeon** announced a partnership focused on silicon anode development, and **StoreDot** entered into a strategic framework agreement with **EVE Energy**, while partnering with **Group14 Technologies** to accelerate commercialization of StoreDot's XFC lithium-silicon cells for electric vehicles. Additionally, automotive OEMs such as **Daimler, Porsche, and GM** have recognized the potential of silicon anodes and have invested in and partnered with silicon anode companies.

In this highly competitive and dynamic environment, it is increasingly crucial to have a strong understanding of the **patent landscape** and the **strategies of key players in technology and intellectual property (IP)**. To meet this need, **Knowmade is releasing a new Silicon Anode Batteries Patent Landscape report**, which aims to clarify the current positions of IP players, analyze their IP strategies, and reveal where industry leaders, newcomers, and start-ups are focusing their R&D efforts.

Silicon Anode Battery Patent Landscape

Time evolution of patent publications



Source: Silicon Anode for Li-ion Batteries - Patent Landscape, KnowMade, September 2024

A dynamic IP landscape

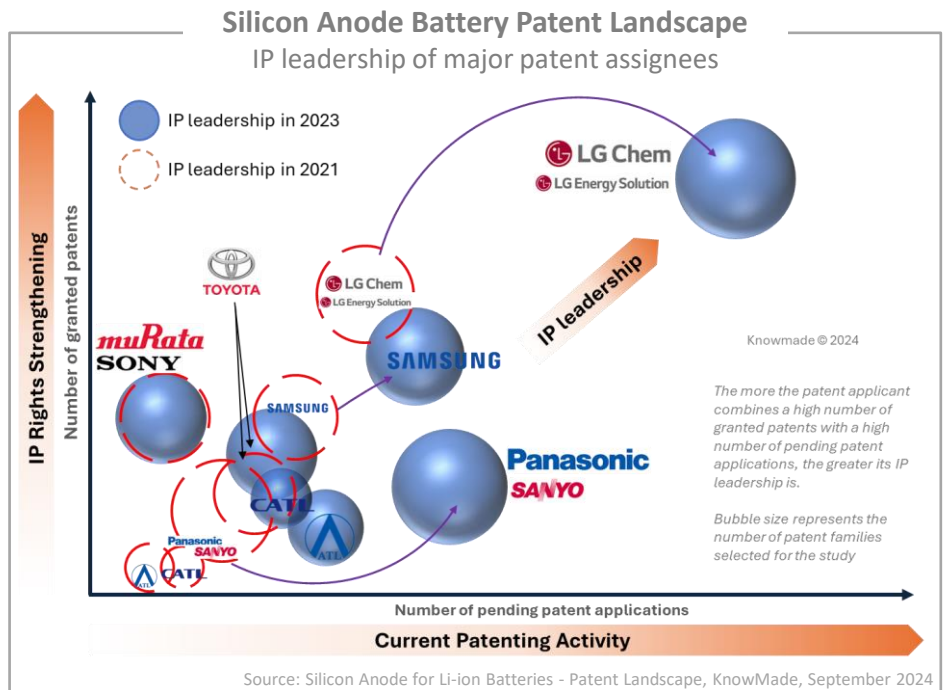
In this report, Knowmade’s analysts have selected and analyzed over 36,700 patents and patent applications from more than 18,200 patent families (inventions) related to silicon anode-based Li-ion batteries. These include patents covering silicon-based materials for anode, silicon-based anodes, and battery cells using a silicon-based anode. The number of patents has increased by more than 47% compared to the initial corpus analyzed in 2021 for our [first report](#), with nearly 6,000 new inventions identified and included in this updated 2024 IP report. This significant rise clearly demonstrates a strong interest in the technology from various entities, including large companies, start-ups, and R&D labs. Over the past two years, several notable companies, such as **Northvolt**, **Solid Power**, and **OLA Electric Mobility**, have entered the patent landscape. Additionally, several IP players already identified in 2021, including **LG Chem/LGES**, **Panasonic/Sanyo**, **Samsung**, and **ATL**, have significantly strengthened their patent portfolios.

Understanding the main trends, the key players’ IP position and IP strategy

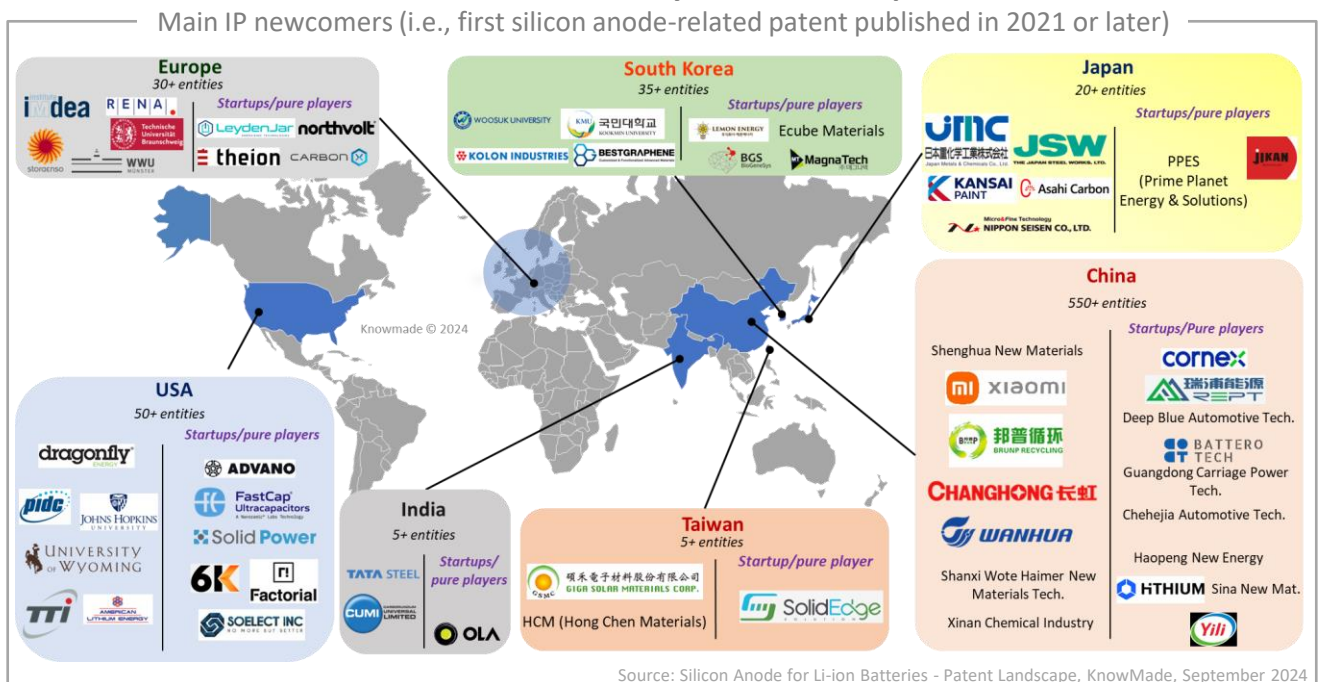
IP competition analysis should reflect the vision of players with a strategy to enter and develop their business in the **silicon anode Li-ion battery** market. In this report, Knowmade’s analysts provide a comprehensive overview of the competitive IP landscape and latest technological developments in this field. The report covers **IP dynamics** and **key trends** in terms of patents applications, patent assignees, filing countries, and patented technologies. It also identifies the **IP leaders**, most **active patent applicants**, and **new entrants** in the IP landscape. The report also sheds light on **under-the-radar companies** and **new players** in this field.

Evolution of leading players’ positions and entry of new patent applicants

LG Chem/LGES is leading the silicon anode battery patent landscape, with strong IP competition from **Samsung**, **Murata**, **Panasonic/Sanyo**, and **Toyota**. Additionally, we have identified over **290 start-ups and pure players** involved in the patent landscape, and more than **650 new entrants** who filed their first silicon anode-related patents in 2021 or later, most of whom are Chinese entities. In dedicated sections of the report, we focus on the **IP portfolios held by key players, start-ups, and newcomers** from various countries.



Silicon Anode Battery Patent Landscape



Useful Excel patent database

This report also includes an extensive **Excel database with** all patents analyzed in this study, including **patent information** (numbers, dates, assignees, title, abstract, etc.) and **hyperlinks to an updated online database** (original documents, legal status, etc.), and **affiliation segments** (anode material, anode, battery cell, other battery cell components).



Companies mentioned in the report (non-exhaustive)

LG Chem/LG Energy Solution, Panasonic/Sanyo, Samsung, Murata Manufacturing/Sony, Toyota, ATL (Amperex Technology), COSMX / COSLIGHT, Guoxuan High Tech Power Energy / Gotion, CATL (Contemporary Amperex Technology Ltd), Global Graphene, SVOLT / Fengchao Energy Technology, General Motors, NEC, SK Group, Enevate, Resonac (Showa Denko / Hitachi Chemical), Shanshan Energy Technology, Mitsubishi Chemical, BYD, EVE Energy, Bosch/SEEO, A123 Systems (Wanxiang group), Sunwoda, Nissan, Tafel New Energy Technology / Zenergy, BTR New Energy Material, Amprius / Berzelius, Nexxon, Mitsui Mining & Smelting, Envision / AESC, Tinci Materials Technology, TDK, Hitachi, JEVE (Tianjin EV Energy), Huawei, Hyundai/Kia, WeLion New Energy Technology, Wacker Chemie, BAK Battery, Hitachi Maxell, GS Yuasa, Mitsui Chemicals, Tianmu Energy Anode Material, CALB (China Aviation Lithium Battery), Yinlong Energy, Furukawa, Toshiba, Kaijin New Energy Technology, Smoothway Electronic Materials, Kunlunchem, Chery Automobile, Fujifilm, MU Ionic Solutions, Ube Corporation, Shin Etsu Chemical, Sumitomo Electric Industries, MGL New Materials, Sound Group, Zeon, FAW (China First Automobile Works), BMW, Umicore, Sekisui Chemical, Capchem Group, Novolyte Technologies, and more.

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ABOUT KNOWMADE

KnowMade is a technology intelligence and IP strategy consulting company specialized in analyzing patents and scientific publications. The company helps innovative companies, investors, and R&D organizations to understand competitive landscape, follow technological evolutions, reduce uncertainties, and identify opportunities and risks in terms of technology and intellectual property.

KnowMade's analysts combine their strong technology expertise and in-depth knowledge of patents with powerful analytics tools and methodologies to turn patent information and scientific literature into actionable insights, providing high added value reports for decision makers working in R&D, innovation strategy, intellectual property, and marketing. Our experts provide prior art search, patent landscape analysis, freedom-to-operate analysis, IP due diligence, and monitoring services.

KnowMade has a solid expertise in Compound Semiconductors, Power Electronics, Batteries, RF Technologies & Wireless Communications, Solid-State Lighting & Display, Photonics, Memories, MEMS & Sensors, Semiconductor Packaging, Medical Devices, Medical Imaging, Microfluidics, Biotechnology, Pharmaceuticals, and Agri-Food.

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Patent Landscape Analysis – September 2024

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“Buyer”: Any business user (i.e. any person acting in the course of its business activities, for its business needs) entering into the following general conditions to the exclusion of consumers acting in their personal interests.

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1. Scope

1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. Any additional, different, or conflicting terms and conditions in any other documents issued by the buyer at any time are hereby objected to by the seller, shall be wholly inapplicable to any sale made hereunder and shall not be binding in any way on the seller.

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