

Solid-State Li-ion Batteries with Inorganic Solid Electrolytes

Patent Landscape Analysis – October 2021

Japanese companies have dominated the patent landscape, but the last 3 years have seen an explosion in Chinese patenting activity, while automakers and numerous pure-play newcomers are entering the game.

REPORT OUTLINE

- Solid-state Li-ion batteries with inorganic solid electrolytes
- Patent landscape analysis
- October 2021
- PDF > 200 slides
- Excel file > 7,300 patent families
- Reference: KM21005



REPORT'S KEY FEATURES:

- **IP trends**, including time-evolution of published patents, countries of patent filings, legal status, etc.
- Ranking of **main patent assignees**.
- **Newcomers** in the IP landscape.
- **Patent categorization by supply chain segments** (electrolyte materials, electrodes, battery cells), **type of electrolyte** (inorganic, inorganic/polymer), and **inorganic electrolyte materials** (sulfide glass ceramics, Thio-LISICON, argyrodite, oxide glass ceramics, NASICON, perovskite, garnet, anti-perovskite, hydride)
- For each segment: **IP dynamics**, ranking of **main patent assignees**, **IP newcomers**, **key IP players**, **key patents**, and **recent developments**.
- **Focus on patent portfolios of key players**: Toyota, Samsung, LG Chem, Panasonic/Sanyo, Idemitsu Kosan, Fujifilm, Bosch/SEEO, Murata/Sony, Hyundai/Kia, QuantumScape, QingTao Energy Development, SVOLT, Ohara.
- For each key players: Time-evolution of **patenting activity**, **legal status** of patents and **countries** of patent filings, **patent segmentation** by electrolyte material, **IP strength** by segments, **key patents** and **recent IP developments**.
- **Excel database** containing **all patents** analyzed in the report, including technology, material segments, and hyperlinks to an **updated online database**.

RELATED REPORTS & MONITORS

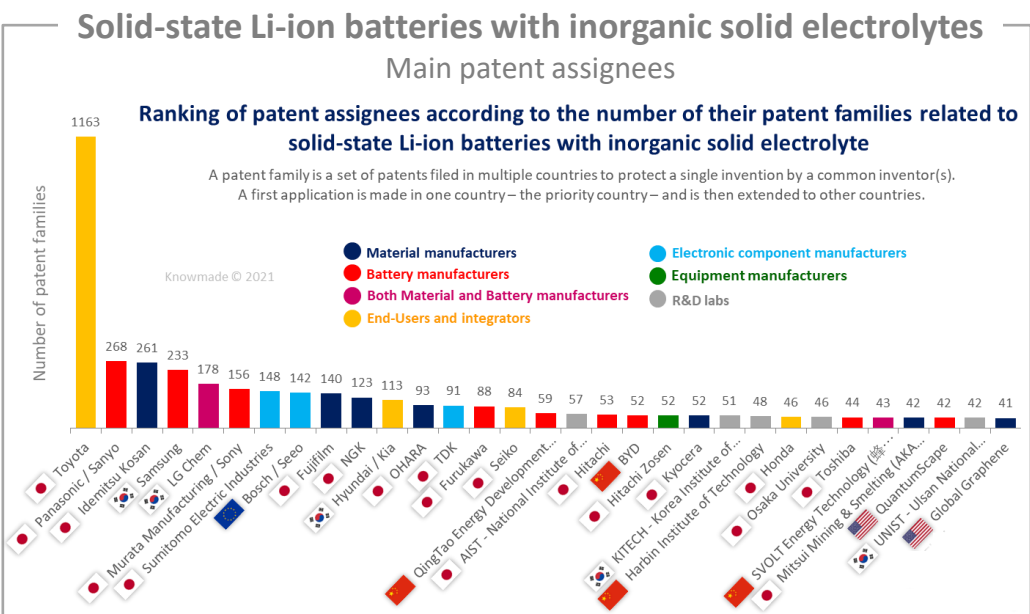
- [Solid Electrolytes for Li-ion Solid-State Batteries](#)
- [Solid-State Batteries Patent Monitor](#)

Japanese players have a good IP position in the solid-state Li-ion battery field

Solid-state batteries with inorganic solid electrolytes hold a key position in the booming developments to get safer Li-ion batteries for electrical vehicles (EV) with greater autonomy and maximum speed. **Solid-state batteries** can be classified into two categories: **thin-film solid-state batteries** and **“bulk” solid-state batteries**. The thin-film technology approach proven for thin-film solid-state batteries is not directly applicable for bulk solid-state batteries. New processes and materials therefore have to be developed to get bulk solid-state batteries up to market requirements (performance, stability, cost). There are currently three main axes for development to enhance bulk solid-state battery performance: improve solid electrolyte performances; improve the electrode/electrolyte interface; and develop material/cell assembly manufacturing processes compatible with industrial production.

Many companies have recently presented solid-state battery prototypes and announced their commercialization and integration in electric vehicles by 2025. However, many questions remain: which **solid electrolyte** has the most promising performance? What are the most recent **technological developments**? Who has the **best position** across the supply chain?

In this context, **Knowmade** is releasing a new **patent landscape** report covering the whole value chain of **solid-state Li-ion batteries with inorganic solid electrolytes** from electrolyte materials to electrodes and battery cells. **Patent landscape analysis** is the perfect complement to market research, to fully comprehend the **competitive landscape** and **technology roadmap**, keep abreast of cutting-edge **technology developments**, **anticipate future technology adoption**, and understand the different competitors' strategies. This kind of patent landscape report reveals the **companies**, **technical solutions** and **strategies** not identified through standard market analysis.



Knowmade's analysts have selected and analyzed more than 14,400 patent filings grouped into 7,300+ patent families (inventions) related to **solid-state Li-ion batteries with inorganic solid electrolytes**. In this report, we reveal the main IP trends, key patented technologies, recent development trends, key IP players and newcomers, their strategies regarding inorganic solid electrolyte materials, and their IP strategies and strengths by supply chain segment and inorganic electrolyte material.

Understand the competitive landscape and IP strategy of key players

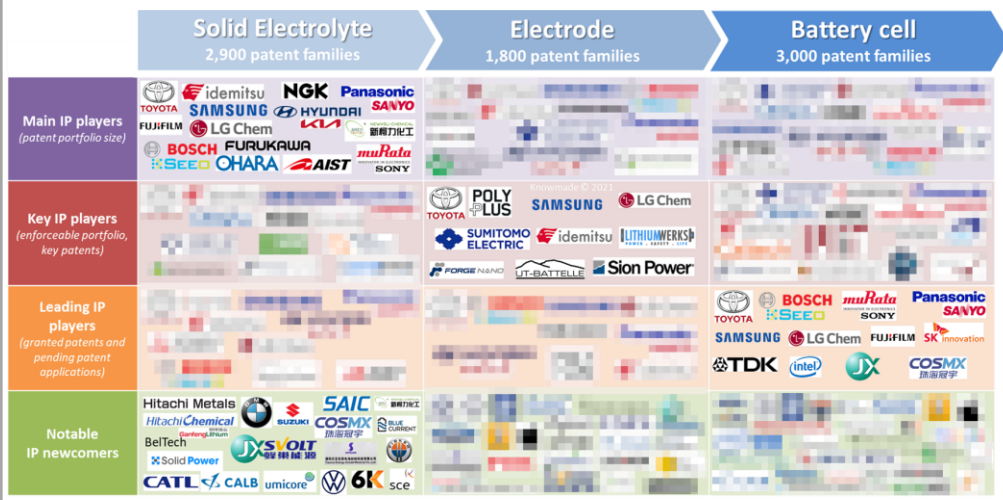
We have identified more than 1,000 different entities that have filed patent applications related to **inorganic-based solid-state Li-ion batteries**. The report provides a clear overview of the **most active patent assignees** as well as a presentation of **newcomers** to the patent landscape. Furthermore, patent segmentation reveals the **IP position of patent assignees by supply chain segment** (electrolyte materials, electrodes, battery cells) through a detailed analysis of their patent portfolios. We also provide insights into the key players' **patented technologies**, their **IP strategy**, and their **ability to limit other firms' patenting activity and/or freedom-to-operate**. The **benchmarking** of patent assignees is evaluated **by supply chain segment**, on the basis of their IP portfolio size, prior-art contribution, geographical coverage of the IP portfolio, and enforceability of their patents. A special focus is placed on the main **IP collaborations** (co-filings, license agreements, transfer of IP rights) related to **solid-state Li-ion batteries with inorganic solid electrolytes**.

Identify the leading IP players and IP newcomers across the supply chain, by electrolyte material

All patents selected for this study have been categorized by **supply chain segment** (electrolyte material, electrode, battery cells), **electrolyte type** (inorganic/polymer, inorganic) and **inorganic electrolyte material** (argyrodite, Thio-LISICON, sulfide glass ceramic, oxide glass ceramic, perovskite, anti-perovskite, LISICON, garnet, NASICON, hydride). For **each supply chain segment**, this report includes a time-evolution of **patent applications**, main and **key patent assignees**, newcomers, and a description of **key and recently patented technologies**. An understanding of the **current technical challenges** addressed in the patents is also presented.

Solid-state Li-ion batteries with inorganic solid electrolyte

Key IP players by supply chain segment



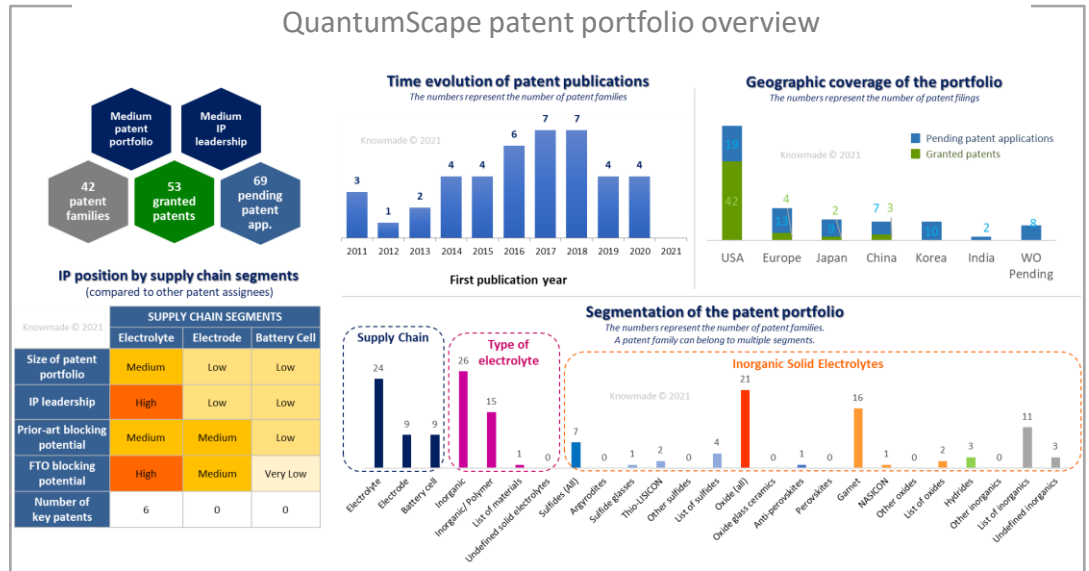
Focus on key players' patent portfolios

The report provides a detailed analysis of a selection of key players: **Toyota, Samsung, LG Chem, Panasonic/Sanyo, Idemitsu Kosan, Fujifilm, Bosch/SEEO, Murata/Sony, Hyundai/Kia, QuantumScape, QingTao Energy Development, SVOLT, and OHARA**.

For each player, we summarize their IP portfolio, highlight their **strengths** and weaknesses by segment, identify their **key patents** and provide information about their **recent IP developments**.

Solid-state Li-ion batteries with inorganic solid electrolytes

QuantumScape patent portfolio overview



Useful Excel patent database

This report also includes an **Excel database with the 7,300+ patent families** (inventions) analyzed in this study. This useful patent database **allows for multi-criteria searches** and includes patent publication numbers, **hyperlinks to an updated online database** (original documents, legal status, etc.), priority date, title, abstract, patent assignees, patent's current legal status, and **segments** (electrolyte materials, electrodes, battery cells, inorganic, inorganic/polymer, sulfide glass ceramics, Thio-LISICON, argyrodite, oxide glass ceramics, NASICON, perovskite, garnet, anti-perovskite, hydride, etc.).



COMPANIES MENTIONED IN THIS REPORT (NON-EXHAUSTIVE LIST)

AGC, Albemarle, Alps Electric, Amperex Technology/TDK, Asahi Kasei, BASF, Belenos Clean Power, Blue Solutions/Bolloré, Bosch/Seeo, BYD, Daiso, DKS, Dow/Corning, FDK, Fujifilm, Fujitsu, Furukawa, GS Yuasa, GLESI (Guilin Electrical Equipment Scientific Research Institute), Hitachi Chemical, Hitachi Maxell, Honda, Honeycomb Energy, Huawei, Hydro Quebec, Hyundai/Kia, Idemitsu Kosan, Ionic Materials, Johnson Matthey, JSR, LG Chem, Lionano, Lishen, Lithium Werks/Valence Technology, Mitsubishi Chemical, Mitsubishi Materials, Mitsui Chemicals, Murata/Sony, Nakajima Industry, NGK, Nippon Chemical Industrial, Nippon Electric Glass, Nippon Shokubai, Nippon Soda, Nissan, NOF, Nohms Technologies, Ohara, Optimumnano Energy, Panasonic/Sanyo, Polyplus Battery, Qingtao Energy, Quantumscape, Saft/Total, Samsung Electronics, Samsung SDI, Schott, Seiko, Shin Etsu Chemical, Sila Nanotechnologies, Solid Power, Solvay, Sumita Optical Glass, Sumitomo Chemical, Sumitomo Metal Mining, Toho Titanium, Toray Industries, Toshiba, Toyota, Wildcat Discovery Technologies, Yuhuang Chemical, Zeon, CEA, CNRS, FZ. Juelich, KAIST, MIT, NIAIST, NIMS, Osaka University, Tokyo Institute of Technology, University of Chicago, University of Colorado, University of Michigan, University Tohoku, etc.

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ABOUT KNOWMADE

Knowmade is a Technology Intelligence and IP Strategy consulting company specialized in analysis of patents and scientific information. The company helps innovative companies and R&D organizations to understand their competitive landscape, follow technology trends, and find out opportunities and threats in terms of technology and patents.

Knowmade's analysts combine their strong technology expertise and in-depth knowledge of patents with powerful analytics tools and methodologies to turn patents and scientific information into business-oriented report for decision makers working in R&D, Innovation Strategy, Intellectual Property, and Marketing. Our experts provide prior art search, patent landscape analysis, scientific literature analysis, patent valuation, IP due diligence and freedom-to-operate analysis. In parallel the company proposes litigation/licensing support, technology scouting and IP/technology watch service.

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ORDER FORM

Solid-State Li-ion Batteries with Inorganic Solid Electrolytes

Patent Landscape Analysis – October 2021

Ref.: KM21005

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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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BIC or SWIFT code: CCBPFRPPMAR

IBAN: : FR76 1460 7003 6360 6214 5695 139

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