Solid-State Li-ion Batteries with Inorganic Solid Electrolytes

Patent Landscape Analysis

October 2021
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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.

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

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A growing number of companies from the whole supply chain (material, battery, car makers) are working on solid-state batteries. In 2020 and 2021, several companies (Toyota, Samsung, etc.) have revealed first battery cells. Most of major companies operating on solid-state batteries plan a mass-production and commercialization by 2025.

In this context, Knowmade releases this year a new patent landscape report covering the whole value chain of solid-state Li-ion batteries with inorganic solid electrolytes from materials of electrolytes to electrodes and battery cells. Knowmade’s analysts have selected and analyzed more than 14,400 patents and patent applications representing more than 7,300 patent families (inventions) filed by more than 1,000 different entities. This 2021 report is complementary to our previous report focused on solid electrolytes materials and published in 2019.

In this Solid-State Batteries Patent Landscape report 2021, Knowmade’s analysts give a comprehensive picture of the solid-state battery competitive landscape and technology developments from a patent perspective.

• What are the IP dynamics and key trends for patents filings, company, countries, and technology?
• Who are the IP leaders, most active players and newcomers?
• Who are the new players or companies that are under the radar?
• What is the IP portfolio strength of key players, and their technology/application focus?
• What is the status of patented technologies, and trends for each technology/application?
• What are the strategic and technological paths leading companies and newcomers are following for inorganic-electrolyte-based solid-state battery technologies?

In this 2021 edition, Knowmade’s analysts detail the IP landscape and noteworthy recent patents related to electrolyte materials, electrodes and battery cells.

All year long, Knowmade’s analysts investigate the solid-state battery patent landscape to get a deep understanding of the technology/IP evolution and business impact. This 2021 edition is part of a collection of battery analyses including Solid Electrolytes for Li-ion Batteries, NMC Li-ion Batteries, Silicon Anode (in progress), etc. Solid-state battery patents and technologies are also tracked and analyzed in the Solid-State Batteries Patent Monitor.
INTRODUCTION
Solid-state batteries: Definitions

• Solid-state batteries are batteries with all components in a solid-state (electrode, electrolyte etc.). They use same chemistries than liquid/gelled batteries (i.e. Lithium-ion batteries, Li-Air batteries, Li-S batteries, Na-ion batteries, Mg-ion batteries etc.) but they have a solid electrolyte.

• In a solid-state batteries, two electrodes are separated by a solid-state electrolyte layer instead of a separator impregnated with a liquid of gelled electrolyte. Solid electrolytes allow the movement of ions without the need for a liquid or soft membrane separating the electrodes. Solid electrolytes can be classified in three categories: inorganic, polymer and inorganic/polymer composites.

Main advantages and drawbacks of solid-state batteries

<table>
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<tr>
<th>Advantages</th>
<th>Drawbacks</th>
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<tr>
<td>• Improved safety (not flammable, no leakage, no thermal runaway, restrict dendrite formation)</td>
<td>• Lower power density (for the moment) due to lower ionic conductivity of solid electrolyte and resistance induced at electrode/electrolyte interface</td>
</tr>
<tr>
<td>• High tolerance to high temperature thus less safety protection/cooling systems are needed</td>
<td>• Requires different manufacturing processes than liquid batteries</td>
</tr>
<tr>
<td>• Improved energy density: It allows the replacement of conventional anodes with lithium metal (higher capacity), thinner cells, large ESW</td>
<td>• High mechanical constraints in the cell</td>
</tr>
<tr>
<td>• No separator membrane required</td>
<td>• More expensive</td>
</tr>
<tr>
<td>• Simpler cell/pack design</td>
<td>• Operation at low temperature may be challenging.</td>
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<tr>
<td></td>
<td>• High pressure is required to maintain electrode contact</td>
</tr>
<tr>
<td></td>
<td>• Electrochemical stability issues with some electrolytes</td>
</tr>
</tbody>
</table>

Today, developed and commercialized solid-state batteries are mainly Lithium metal and lithium-ion batteries. This trend is also observed in patents. However, in 2017, some companies published new patent families related to other solid batteries technologies. Toyota, Denso and several Chinese universities published new patent families related to solid Li-Air batteries (WO2017159420, JP2017168190). Tokyo Electric Power and several Chinese universities published new patent families related to solid Li-S batteries (WO2017155011). Toyota and Karlsruhe Institute of Technology published new patent families related to solid electrolytes for magnesium batteries (US9716289, US9640836) both already granted. SK Innovation, Toyota, Sila Nanotechnology and Forschungszentrum Jülich published new patent families related to solid-state sodium-ion batteries (WO2017059838, WO2017106563, WO2017102011, KR20170078210).
INTRODUCTION
Solid thin-film battery vs “Bulk” solid battery

Solid-state batteries can be classified in two categories: Thin-film solid-state batteries and “bulk” solid-state batteries. Thin-film technology approach proven for thin-film solid-state batteries are not directly applicable for bulk solid-state batteries. Thus, new processes and materials have to be developed to get bulk solid-state batteries reaching market requirements (performances, stability, costs).

"Bulk" solid-state batteries

- Large batteries such as those used in electric cars
- Maturity:
  - Inorganic: Under development
  - Polymer: Commercialized by Blue Solutions (Operate at 60-80°C)
- Applications:
  - Electric vehicles, Consumer devices

Thin-film solid-state batteries

- Miniature batteries with very small energy capacity
- Maturity:
  - Commercially available
- Applications:
  - Consumer electronics, Microelectronics

Potential future market players

Main market players
This report provides a detailed picture of the patent landscape related to solid-state batteries with inorganic solid electrolytes, covering the whole value chain (electrolyte materials, electrodes, battery cells). We have selected and analyzed more than 14,400 patents and patent applications published worldwide up to February 2021, representing more than 7,300 patent families (inventions) relevant to the scope of this report.
The patents selected for the corpus of this report have been categorized as shown in the table. Note that patents can belong to multiple segments.

### SOLID-STATE Li-ION BATTERY

#### SUPPLY CHAIN SEGMENTS
- Electrolyte materials
- Electrodes
- Battery cells

#### TYPE OF ELECTROLYTES
- Inorganic
- Inorganic/Polymer

#### INORGANIC ELECTROLYTE MATERIALS
- Oxide inorganic materials
  - Oxide Glass Ceramic
  - Garnet
  - NASICON
  - Perovskite
  - Anti-Perovskite
  - List of oxide materials
  - Other oxide materials
- Sulfide inorganic materials
  - Sulfide Glass Ceramic
  - Thio-LISICON
  - Argyrodite
  - List of sulfide materials
  - Other sulfide materials
- Other inorganic materials
  - Hydride
  - List of inorganic materials
  - Undefined inorganic materials

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KEY FEATURES OF THE REPORT

➢ The report provides essential patent data for batteries using inorganic solid electrolytes, from materials of electrolytes to electrodes and battery cells.

➢ It provides in-depth patent analyses of key technologies and key players including:
  - Main IP dynamics and key trends.
  - IP leaders, most active players and newcomers.
  - IP portfolio strength of key players, and their technology/application focus.
  - Time evolution of patents filings by company, countries, and technology.
  - Current legal status of patents.
  - Joint developments, IP collaborations and IP transfers between key organizations.
  - Insights into the status of technologies, identifying trends for each technology/application.
  - Key patents.

➢ This report also includes an extensive Excel database with the 7,300+ patent families analyzed in this study. This useful patent database allows for multi-criteria searches and includes patent publication numbers, hyperlinks to the original documents, priority date, title, abstract, patent assignees, patent’s current legal status, and segments (electrode, battery cell, electrolyte inorganic, inorganic/polymer, argyrodites, sulfide glasses, thio-LISICON, oxide glass ceramics, perovskites/anti-perovskites, LISICON, garnet, NASICON, hydrides, etc.).

Disclaimer: This report does not provide any insight analyses or counsel regarding legal aspects or the validity of any individual patent. Knowmade is a research firm that provides technical analysis and technical opinions. Knowmade is not a law firm. The research, technical analysis and/or work proposed or provided by Knowmade and contained herein is not a legal opinion and should not be construed as such.
WHY STUDY THE PATENT LANDSCAPE

Understanding the **competitive landscape** and **technology developments** from a **patent perspective**

- **Key IP players** (key patents, IP strategy, technology roadmap)
- **Newcomers** (technology and markets of interest)
- **Technology trends & Emerging technologies**
- **Benchmark patent portfolios** (competitors’ strength & weakness)
- **Key patents** (blocking, valuable)
- **Key technical solutions**
- **Risks** (patent infringement, new entrants, etc.)
- **Opportunities** (partnership, technology acquisition, licensing, etc.)

Perfectly complement market research

Give another point of view of the competitors, technologies and markets

Links between patents and
- **Key market players**
- **Supply chain**
- **Technology Readiness Levels (TRL)**
- **Market product**
- **Emerging technologies/applications**
- **Forecast**
**METHODOLOGY**

Methodology for patent search and analysis

**Phase I**
- **Keywords and term-set definition**
- **Search equations / Search strategy**

**Phase II**
- **Manual screening of the results**

**Phase III**
- **Patent categorization** (by technology, application, supply chain ...)

- **Patent classification**
  - Relevant
  - Non relevant

  - Refine search using patent classes (IPC, CPC) and citations analysis

  - Patent categorization of relevant patent families by technology, application or supply chain

**Worldwide patent database** (Questel-ORBIT)

- Provides 100+ million patent documents from 100 offices (USA, Japan, Europe, China, Korea, Taiwan, Hong Kong, Singapore, etc.)

**IP analysts** with PhD degree combining technical and patent expertise. Manual screening of patent pools with patent classification between relevant & non relevant patent families based on their technical content & scope of the claims. Categorization of relevant patent families by technology, application or supply chain.

**Patent landscape** (overall and by segment)

**Ranking of IP players and identification of key patents**

**In-depth analysis of key players and key patents**

**IP analysts** using powerful analytics tools and proprietary methodologies for IP business intelligence.
INTRODUCTION

Challenges and envisioned technical solutions

**INTRODUCTION**

Challenges in battery field

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Improvement solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Increase battery performance (energy and power density, charge duration, lifetime, performance in extreme environments)</td>
<td>• Develop new electrode materials, electrolytes and separators</td>
</tr>
<tr>
<td>• Decrease battery costs</td>
<td>• Decrease battery costs</td>
</tr>
<tr>
<td>• Decrease the volume of non-energy related materials (cables, housings, etc.)</td>
<td>• Use non-energy related materials (cables, housings, etc.)</td>
</tr>
<tr>
<td>• Increase safety risk (fire/explosion risk, environment contamination)</td>
<td>• Increase safety risk (fire/explosion risk, environment contamination)</td>
</tr>
<tr>
<td>• Reduce the volume of non-energy related materials (cables, housings, etc.)</td>
<td>• Reduce the volume of non-energy related materials (cables, housings, etc.)</td>
</tr>
<tr>
<td>• Increase safety risk (fire/explosion risk, environment contamination)</td>
<td>• Increase safety risk (fire/explosion risk, environment contamination)</td>
</tr>
</tbody>
</table>

**INTRODUCTION**

Challenges and improvement solutions for “Bulk” solid-state lithium battery

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Improvement solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improve solid electrolyte performance (ionic conductivity at room temperature, electrochemical and chemical stability (notably against lithium), resistance to mechanical stress induced by volume change during charging/discharge)</td>
<td>• Improve solid electrolyte performance (ionic conductivity at room temperature, electrochemical and chemical stability (notably against lithium), resistance to mechanical stress induced by volume change during charging/discharge)</td>
</tr>
<tr>
<td>• Improve electrode/electrolyte interface</td>
<td>• Improve electrode/electrolyte interface</td>
</tr>
<tr>
<td>• Improve lithium metal stability</td>
<td>• Improve lithium metal stability</td>
</tr>
<tr>
<td>• Decrease battery costs</td>
<td>• Decrease battery costs</td>
</tr>
</tbody>
</table>

**INTRODUCTION**

Overview of main technical issues for “Bulk” solid-state lithium batteries

- **Solid Electrolytes**
  - Improve solid electrolyte performance
  - Improve battery performance (energy and power density, capacity, maximum voltage) and safety

- **Electrode/electrolyte interface**
  - Improve electrode/electrolyte interface
  - Reduce global battery cell resistance and thus improve its power density and safety

- **Battery manufacturing**
  - Develop manufacturing processes compatible with industrial production
  - Reduce material usage for large scale production and commercialization

**INTRODUCTION**

Impact of main “Bulk” solid-state battery technical issues on its performances

Three main developments axes have been envisioned to improve performances of “Bulk” solid-state batteries: solid electrolytes, electrode/electrolyte interface and materials/cell assembly processes. Impact of solid electrolyte properties, electrode/electrolyte interface properties and material/cell assembly processes on battery performance are represented on the scheme below.
PATENT LANDSCAPE OVERVIEW

Time evolution of patent publications and main patent applicants

- 16,483 patent applications grouped in 2,881 patent families® (inventions), including 8,639 granted patents and 6,591 pending patent applications

**Innovation triggers**
- First publication year
- Patent applications (primary and extensions)
- Patent families (inventions)

**Phase I**
- The increase of patenting activity is driven by China, followed by South Korea and the USA.

**Phase II**
- Innovation of Gold
- Innovation of China

**Phase III**
- Innovation of China
- Innovation of Japan
- Innovation of India

**Phase IV**
- Innovation of China
- Innovation of Japan
- Innovation of India

**Phase V**
- Innovation of China
- Innovation of Japan
- Innovation of India

*Note: The data corresponding to the year 2013 is one complete year patent search was done in February 2013.

PATENT LANDSCAPE OVERVIEW

Time evolution of patent publications by type of solid electrolyte

- Patent families (inventions)
- Number of patent families (Histogram)
- As of February 2021

- **Traditional electrolytes**
- **Inorganic solid electrolytes**
- **Polymer electrolytes**
- **Other inorganic electrolytes**
- **Liquid electrolytes**

PATENT LANDSCAPE OVERVIEW

Time evolution of patent publications by filing country

- Number of patent families
- 1st publication year

- **Chinese patent applications**
- **Japanese patent applications**
- **US patent applications**
- **European patent applications**

PATENT LANDSCAPE OVERVIEW

Main patent assignees – Time evolution of patent publications

- The data corresponding to the year 2013 is one complete year patent search was done in February 2013.
PATENT LANDSCAPE OVERVIEW

Main patent assignees

PATENT LANDSCAPE OVERVIEW
Main patent assignees (1/2)

- More than 1,000 different assignees filed for patents related to solid-state batteries using inorganic solid electrolytes. The top 10 are highlighted in the table.
- The patent landscape is qualitatively dominated by Japanese companies from all the value chain (material manufacturers, battery manufacturers, exclusives and integrators). The two main Korean battery companies (LG Chem and Samsung) are also among the top.

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PATENT LANDSCAPE OVERVIEW
Main patent assignees by company type

Material Manufacturers
- Idemitsu
- LG Chem
- Panasonic
- Samsung
- SK Innovation

Battery Manufacturers
- Honda
- Toyota
- Mazda
- Nissan
- Honda

End-Uses and Integrators
- Toyota
- Honda
- Nissan

Electronic Component Manufacturers
- Infineon
- Bosch
- Stellantis
- Continental

R&D Labs
- AIST
- KITECH

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PATENT LANDSCAPE OVERVIEW
Most active patent applicants since January 2020

Ranking of patent assignees according to the number of their patent families published since January 2020

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PATENT LANDSCAPE OVERVIEW
Legal status and countries of patent filings

PATENT LANDSCAPE OVERVIEW
Current legal status of patents

PATENT LANDSCAPE OVERVIEW
Geographical distribution of granted patents and pending patent applications

PATENT LANDSCAPE OVERVIEW
Geographical coverage of granted patents and pending patent applications

PATENT LANDSCAPE OVERVIEW
Main patent assignees – Geographical coverage of IP portfolios
PATENT SEGMENTATION BY SOLID ELECTROLYTE MATERIALS

Segmentation by supply chain segments

PATENT LANDSCAPE OVERVIEW
Time evolution of patent publications by supply chain segment

As of February 2021

PATENT LANDSCAPE OVERVIEW
Ranking of main patent assignees by supply chain segment

PATENT LANDSCAPE OVERVIEW
Noteworthy IP players by supply chain segment

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PATENT SEGMENTATION BY SOLID ELECTROLYTE MATERIALS

Detailed analysis of competitive landscape for supply chain segments

Competitive landscape: main patent assignees, key IP players and IP newcomers for each supply chain segment (electrolyte materials, electrode, battery cell)
PATENT SEGMENTATION BY SOLID ELECTROLYTE MATERIALS
Detailed analysis of technology landscape for supply chain segments

INORGANIC SOLID-STATE BATTERY CELL
Transferability of existing production methods

INORGANIC SOLID-STATE BATTERY CELL
Main processes routes envisioned for separator/electrolyte layer production

Key patents and recent patented technologies with specification of patented materials

Technology developments and key patents for each supply chain segment (electrolyte, electrode, battery cell)
INORGANIC SOLID ELECTROLYTES

Ionic conductivities of main inorganic solid electrolyte materials

INORGANIC SOLID ELECTROLYTES
Properties of main inorganic solid electrolyte materials

- Oxides
- Sulfides
- Others

Oxide glass-ceramics
- LiO (Li2O, TiO, GeO), (Al, Fe, Ti, Zr, P, O)
- LiO (Li2O, Al2O3, TiO2, TiO, etc.

Sulfide glass-ceramics
- LiS-P, Li-M, etc.
- Sulfide glass-ceramics

Overview of main inorganic solid electrolyte materials

- Oxides
- Sulfides
- Others

Patenting activity

Categories of inorganic solid electrolytes
Properties of materials
Ionic conductivities

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### IP profiles of key IP players

#### COMPANY A

**Main Recent developments**

#### Key patented technologies

**COMPANY A**

**Patent portfolio segmentation and time evolution of patent publications**

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<tbody>
<tr>
<td>Supply chain</td>
<td>Electrolyte</td>
<td>Battery cell</td>
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</table>

#### MATRIX Electrolytes vs. Supply Chain

**COMPANY A**

**Matrix Electrolytes vs. Supply Chain**

- **Supply Chain**
  - Electrolyte
  - Battery cell

**Type of electrolytes**

- Sodium
- Lithium
- Others

**Inorganic solid electrolytes**

- Sodium
- Lithium
- Others

#### Overview of players' IP strategies and IP position by supply chain segments (electrolyte materials, electrode, battery cell)

- **COMPANY A**
  - **Patent portfolio overview**
  - **Time evolution of patent publications**
  - **Geographic coverage of the portfolio**

- **Key patents and recent technology developments**

- **IP dynamics, patenting activity, and IP position for main patent assignees and key IP players** (focus on 10+ players’ IP portfolio)

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Useful Excel file containing all the patents analyzed in this report with corpus segmentation.

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 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.)
ORDER FORM

Solid-State Li-ion Batteries with Inorganic Solid Electrolyte

Patent Landscape Analysis – October 2021

Ref.: KM21005

PRODUCT ORDER

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For price in dollars, please use the day’s exchange rate.
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Terms of Conditions of Sales

DEFINITIONS

1. “Acceptance” means that by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by signing the purchase order which mentions “I hereby accept Knowmadé’s Terms and Conditions of Sale”.

2. “Buyer” means 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 personal interests.

3. “Contracting Parties” or “Parties” means the Seller on the one hand and the Buyer on the other hand.

4. “Intelectual Property Rights” (“IPR”) means any rights held by the Seller in its Products, including any patents, trademarks, registered designs, copyrights, inventions, commercial secrets or knowhow, technical information, company or trading names and any other intelectual property rights or similar in any part of the world which may have been or not be registered or not including any pending registration of one of the above mentioned rights.

5. “License” means: For the reports and databases, 2 different licenses are proposed. The buyer has to choose one license from the following:

   a. One user license: a single individual at the company can use the report.
   b. Multi user license: the report can be used by unlimited users within the company. Subsidiaries are not included.

6. “Products” means: Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

   a. “Seller” means: Based in Sophia Antipolis (France headquarters), Knowmadé is a technology intelligence company specialized in the field of business intelligence.
   b. “We” provide patent landscapes and scientific state of the art with high added value to businesses and research laboratories. Our intelligence digests play a key role to define your innovation and development strategy.

1. SCOPE

4.1 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 HEREBY AND SHALL NOT BE BINDING IN ANY WAY ON THE SELLER.

4.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivalent consent by any duly authorized person representing the Buyer. For these purposes, the Buyer accepts to be bound to the terms and conditions of the Knowmadé’s Terms and Conditions of Sale”. These results in acceptance by the Buyer.

4.3 Or are deemed to be accepted only upon written acceptance and confirmation by the Seller, within [7] days from the date of order, to be sent either by email or to the Buyer’s address. In the absence of any confirmation in writing, orders shall be deemed to have accepted.

2. MAILINGS OF THE PRODUCTS

5.1 Products are sent to the Buyer:

   a. within [1] month from the order for Products already released; or
   b. within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.

5.2 Some weeks prior to the release date the Seller can propose a pre-release discount to the Buyer.

The Seller shall by no means be responsible for any delay in respect of article 2.2 above, and including in cases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality product.

5.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions indicated in paragraph 3.

5.4 The mailing is operated through electronic means either by email via the sales department. If the Product’s electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

5.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.

5.6 In the event of damages to the Product, the Seller undertakes to replace the Product without prior information to the Buyer, even in case of delayed delivery. Any Product returned to the Seller without providing prior information to the Seller as required under article 2.5 shall remain at the Buyer’s risk.

3. PRICE INVOICING AND PAYMENT

3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are expressed to be inclusive of all taxes. They may be reevaluated from time to time in case of variations in the price of the Product, or by any other cause.

3.2 Payments due by the Buyer shall be sent by cheque payable to Knowmadé, PayPal or by electronic payment, within the one applicable at the time of the order and in accordance with the payment terms.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the Buyer shall pay interest on the outstanding due based on the annual rate Ref of the «ECS > 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications [report, database, tool...] are delivered only to the Buyer in France and are not available to any third party, material breach of this agreement.

3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

4. LIABILITIES

4.1 The Seller or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and consequences he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.

4.2 The Seller shall only be liable for:

   a. (i) and (ii) foreseeable pecuniary loss, caused by the Products or any event as a result of a Product
   b. in no event shall the Seller be liable for:

   i. any special, incidental, consequential or indirect damages, including, but not limited to, the losses of profits, business interruption and loss of programs or information arising out of the use or inability to use the Seller’s website or the Products, or any information provided in or via the website, in the event of, or in connection with, the use of the Products or the information contained in the Products.
   ii. any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof
   iii. all the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which is subject to change without prior notice.

4.3 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified or substituted with the exclusion of the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

4.4 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labor costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for the Buyer.

4.5 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the contract. The Buyer shall use the information contained in the Products at his own risk.

4.6 The Buyer is entitled to request from the Seller any information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment in the exclusion of any further damages.

4.7 The Seller does not make any warranties, express or implied, including, without limitation, those of saleability and fitness for a particular purpose, with respect to the Products. Although the Seller take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes which could damage your computer system, the Buyer is responsible for ensuring that any software code downloaded from the Products is compatible and safe for use.

5. FORCE MAJEURE

5.1 The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labor difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control of the Seller, or which the Seller incurs no fault or responsibilities for your actions.

6. PROTECTION OF THE SELLER’S IPR

6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.

6.2 The Buyer agrees not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company. The Buyer shall have the right to use the Products for internal business purposes only, for all internal and international purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

   i. information storage and retrieval systems;
   ii. - use in any time-sharing, service bureau, bulletin board or similar arrangement or public display;
   iii. any other use that is not used directly by the Buyer in its business or the internal services of the Buyer’s websites or the internal services of the Buyer’s employees.

6.3 The Buyer shall be solely responsible to the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respecting the copyright and will guarantee that the Products are not disseminated out of the company.

7. TERMINATION

7.1 If the Buyer cancels the order in whole or in part postpones the date of mailing, the Seller shall notify the Buyer of the modifications or cancellation. The Buyer may, in such case, apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.

7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of thirty (30) days without solving the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

8. MISCELLANEOUS

8.1 All the provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, licensees, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer.

8.2 Neither the Seller nor any of its Subsidiaries under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

8.3 The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

9. GOVERNING LAW AND JURISDICTION

9.1 Any dispute arising out or linked to these Terms and Conditions or to any contract (orders) or contracts (transactions) to which these Terms and Conditions shall apply shall have jurisdiction under such issues.

9.2 For any dispute arising out of or linked to this Agreement or any contract or order, the Seller shall have the right and power to settle the dispute in its own name and in its own discretion.
Turning **patents** and **scientific information** into **business-oriented report** for decision makers working in **R&D**, **Innovation Strategy**, **Intellectual Property**, and **Marketing**

Competitive landscape | Technology trends | Opportunities / Risks | R&D and IP strategy

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**Intellectual Property**

- Patent your inventions
- Assert your patents and defend your position in case of licensing/litigation
- Evaluate the risks to infringe patents

**Innovation Strategy**

- Understand, anticipate and evaluate the competitive landscape and current technology developments
- Improve your R&D and IP strategy
- Identify and get access to external innovation

*Prior art search, Freedom-to-operate analysis, Patent invalidation, Evidence of use, Patent valuation*

*Patent landscape, Monitoring service, IP due diligence*

*Technology scouting, Scientific literature analysis*
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Patent Monitoring Service to track current R&D activity and early detect weak signals, opportunities and risks

Monthly IP database | Quarterly report Access to IP analysts
MAIN FIELDS OF EXPERTISE

Communication
- RF, Microwaves, mm-Waves
- RF Front End Module
- Antenna & Networks
- Digital Optic Communication (datacom, telecom, photonics)

Energy Mgt & Storage
- Power electronics
- Batteries & Fuel-cell
- Power management
- PV

MEMS, Sensors & Optoelectronics
- Micro-systems
- Sensors & Imaging
- Lighting & Display

Advanced Packaging

Innovative Materials

AI & Computing

Life Sciences & Healthcare
- MedTech
- Microfluidics
- Biotech & Pharmaceutics
- Agrifood
Solid-State Li-ion Batteries with Inorganic Solid Electrolytes – Patent Landscape Analysis | October 2021 | Ref.: KM21005

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Whole Battery Supply Chain

- Materials
- Components
- Battery cell
- Battery Packs (BMS, thermal management, etc)
- Recycling
- Manufacturing

Key Battery Technologies

- Lithium battery
- Ni-MH battery
- Zn-Air battery
- Lead-Acid battery
- Na-S battery
- Redox flow battery
- Li-Air battery
- Li-S battery
- Na-ion battery
- Mg-ion battery

All Battery applications

- Automotive
- Consumer
- Stationary
- Medical

All Battery Cell Designs

- Cylindrical
- Prismatic
- Flexible
- Thin film / Microbattery

BATTERY

Knowmade expertise
BATTERY

Off-the-shelf reports

Click on the picture to access to the flyer and sample

ELECTROLYTES
- Liquid, gelled, solid, ionic liquids, solvents, salts, additives, etc.

REPORT
- Solid Electrolytes for Li-ion Solid-State Batteries (2019)

CATHODE
- NMC, NCA, LFP, LMO, etc.

REPORT
- NMC Li-ion Battery (2017)

SEPARATOR

ANODE
- Graphite, Silicon, LTO, Lithium, etc.

REPORT
- Silicon Anode for Li-ion Battery (2021)

Other materials:
- Current collector, binder, additives, etc.

REPORT
- Status of Battery Patents (2018)

REPORT
- Microbattery (2016)
CONTENTS

Quarterly IP database (up-to-date Excel file)
- New patent applications
- Patents newly granted
- Expired or abandoned patents
- Transfer of IP rights (re-assignment, licensing)
- Patent litigation & opposition
- Patent categorization by:
  - Supply Chain: Electrolyte, Electrode, Battery, Pack
  - Type of electrolyte materials: Inorganic, Inorganic/polymer, Polymer
  - Inorganic electrolyte materials: Sulfide Glass Ceramic, Thio-LISICON, Argyrodite, Oxide Glass Ceramic, NASICON, Garnet, Perovskite, Anti-Perovskite, LISICON, Hydride, etc.

Quarterly IP report (PDF slide deck)
On a quarterly basis, this report will provide the IP trends over the last three months, with a close look to key IP players and key patented technologies.

Access to an IP analysts (100 hours per year)
Q&A session and discussion with our IP analysts regarding trends, analyses, specific patented technologies or company’s IP portfolio in the field Solid-State Batteries.

WHY YOU SHOULD SUBSCRIBE

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✓ Mitigate patent infringement risks
✓ Take advantage of free technologies

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