

PATENT MONITOR

Solid-State Batteries

Quarterly Report

Q2 2021

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Production chain position vs. Electrolyte materials (number of patent families and main patent assignees)

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FOCUS ON MAIN IP PLAYERS OF THE QUARTER **38**

- Toyota
- Samsung
- Murata/Sony
- Panasonic/Sanyo
- Enevate
- Cosmx Battery

For each patent assignee:

- Overview of IP activity
- Production chain position vs. Electrolyte materials
- Notable patents selected by Knowmade analyst

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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.

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, Pharmaceuticals, and Agri-Food.

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INTRODUCTION



METHODOLOGY

Scope of solid-state batteries patent monitor

- This report covers patents published/granted/abandoned/expired in **Q2 2021**, from April 2021 to June 2021, and it provides a detailed picture of the **IP activity** related to **solid-state batteries**. In that period, Knowmade has selected and analyzed all patents related to electrolyte, electrode, separator, battery cell, and battery pack.
- The data are extracted from the **FamPat worldwide patent database** (Questel-ORBIT) which provides 100+ million patent documents from 100+ worldwide patent offices (US, Japan, Europe, China, Korea, Taiwan, etc.). The patents are grouped in **patent families**. A patent family is a set of patent applications filed in multiple countries to protect a single invention by a common inventor(s).
- Both the **selection of relevant patents** and **their categorization in technical segments** are **manually** performed using **keywords analysis** of patent title, abstract, claims and description, combined with **patent classes** (IPC, CPC), and in conjunction with **expert review** of the subject-matter of inventions.

Included

Patents related to:

- **Solid electrolytes for Li-ion batteries** (including polymer, inorganic and polymer/inorganic composite electrolytes).
- **Electrodes for solid-state Li-ion batteries*** (core-shell electrode materials containing solid electrolytes materials, electrode containing solid electrolytes materials, etc.).
- **Solid-state Li-ion batteries*** (i.e. Lithium metal batteries and Li-ion batteries) and their manufacturing methods.

*Including polymer, inorganic and polymer/inorganic composite electrolytes

Not included

Patents related to:

- Other solid-state batteries (Li-S battery, Li-Air battery, Na-ion battery, Mg-ion battery etc.)
- Solid electrolytes without references to their use in Lithium batteries in the patent full text
- Gelled electrolytes
- Coin-cell solid-state batteries
- Thin Film Solid-state batteries
- Microbatteries with solid electrolytes

METHODOLOGY

Segment definition

Patents have been manually categorized according to their current legal status, and their technologies/applications

SEGMENTATION BY LEGAL STATUS

NEW PATENT: New patent families (inventions) published during the quarter (extensions from older patent families are excluded).

GRANTED PATENT: Patents granted during the quarter (granted patents from older patent families containing already granted patents are excluded).

DEAD PATENT: Patents expired or abandoned during the quarter.

PATENT TRANSFER: Re-assignments (IP transfers) during the quarter.

SEGMENTATION BY TECHNOLOGIES/APPLICATIONS

Production chain position:

- **Electrolyte:** Inventions mainly claiming electrolyte material (composition and/or manufacturing methods).
- **Electrode:** Inventions mainly claiming electrode material or layer including solid electrolyte material (composition and/or manufacturing methods).
- **Battery cells:** Inventions mainly claiming solid-state battery cells (composition and/or manufacturing methods).
- **Battery Pack:** Inventions mainly claiming battery packs containing solid-state batteries.
- **Separator:** Inventions mainly claiming a separator containing solid electrolyte materials (composition and/or manufacturing methods).

Type of solid electrolyte:

This segmentation produces the following technological segments: **Inorganic, Inorganic/Polymer, Polymer, List of materials, Undefined solid electrolytes**

Inorganic solid electrolyte materials:

This segmentation produces the following technological segments:

- **Sulfides (all), Argyrodites, Sulfide Glass Ceramics, Thio-LISICON, Other sulfides, List of Sulfides**
- **Oxides (all), Oxide Glass Ceramics, Anti-Perovskite, Perovskite, LISICON, Garnet, NASICON, Other oxides, List of Oxides**
- **Hydrides, Other inorganics, List of inorganics, Undefined Inorganics**

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PATENT MONITOR

Take advantage of quarterly updates on IP activities

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ANNUAL SUBSCRIPTION

12 months

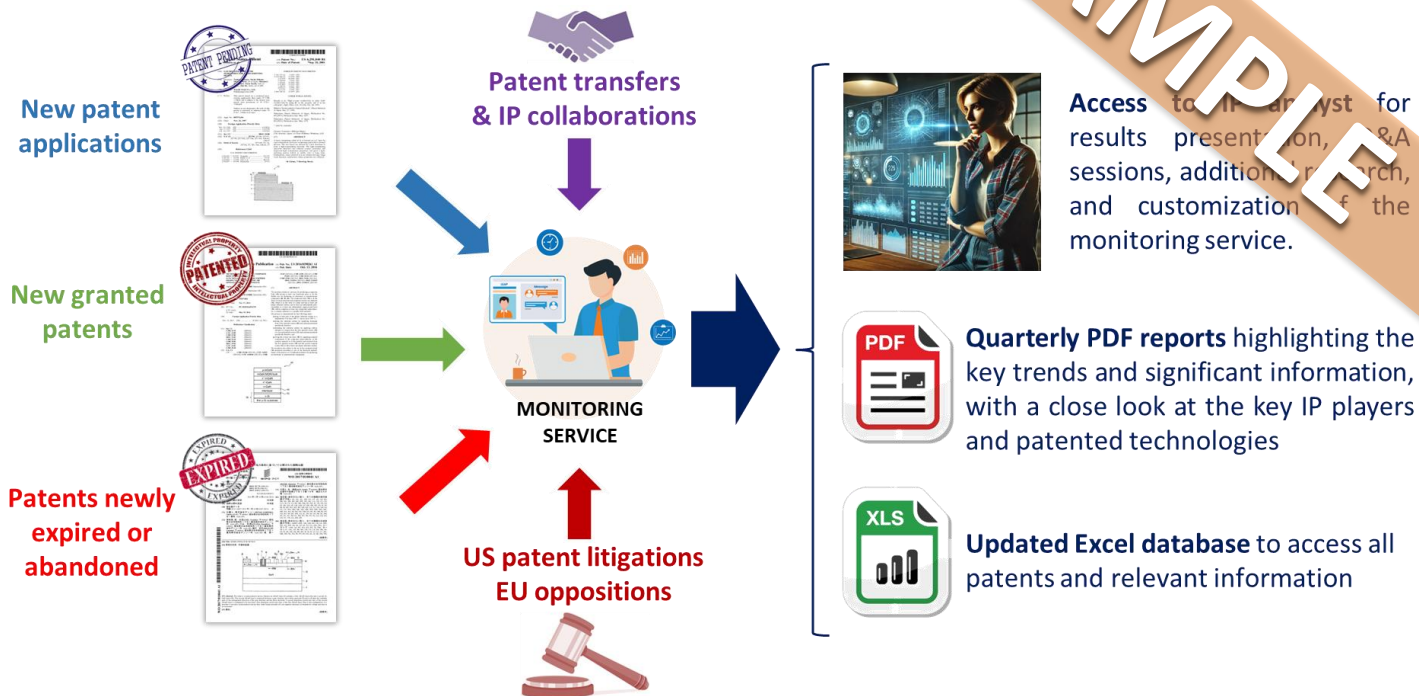
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Every quarter

- One-hour presentation of results, Q&A, and discussions.
- **PDF report** highlighting the key trends and significant information, with a close look at the key IP players and patented technologies.
- Updated **Excel database** to access all patents and relevant information (*new patents applications, granted patents, expired or abandoned patents, patent transactions, IP collaborations, patent litigations and oppositions*)

Throughout the year

- **Direct access to the IP analyst**
 - to address any inquiries you may have regarding reports' results.
 - to conduct additional research on specific technologies or companies' patent portfolios.
 - to customize the monitoring service by adding specific players and/or specific segments.



WHY YOU SHOULD SUBSCRIBE

- ✓ Track your **competitors**, partners or clients
- ✓ Identify **newcomers** to your technology field
- ✓ Early detect **opportunities** and **risks** for your business
- ✓ Get a clearer view of the **technology evolution**
- ✓ Identify emerging research areas and **cutting-edge technology** developments
- ✓ Mitigate patent **infringement risks**
- ✓ Take advantage of **free technologies**

PATENT MONITOR

Quarterly report

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.

- Main patent applicants, their notable patent filings and technologies.
- New entrants and their patents.
- Technology trends and notable patented technical solutions.
- Key patents newly granted, their owners and claimed inventions.
- Main IP right transfers (reassignments, licensing agreements).
- Key patents newly expired or abandoned, their owners and their potential market impact.
- Noteworthy news on patent litigation and opposition, plaintiffs and defendants, patents and products involved.

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Q1 2019 KEY FACTS Introduction

Key facts of the quarter:
228 NEW PATENT APPLICATIONS
134 GRANTED PATENTS
1 PATENT TRANSFER
25 DEAD PATENTS

Q1 2019 KEY FACTS Applications versus Value Chain (Newly granted patent)

	Wafer & Epitaxial	Device	Module & Packaging	Circuits
Power Applications	Qorvo (1 Invention) Toshiba (1 Invention) Renesas Electronics (1 Invention) Air Water (1 Invention) Maxim (1 Invention)	Renesas Electronics (8 Inventions) Toshiba (4 Inventions) UESTC (4 Inventions) Fuj Electric (2 Inventions) Power Integrations (2 Inventions)	Panasonic (3 Inventions) Nuvoton (1 Invention) OIS (1 Invention) Horiba International University (1 Invention) South China University of Technology (1 Invention)	Infineon (2 Inventions) Nuvoton (2 Inventions) Renesas (1 Invention) GaN systems (1 Invention) Transphorm (1 Invention) Toshiba (1 Invention)
		Suichou Hanhua Semiconductor (苏州汉华半导体有限公司) (1 Invention)	Delta Semiconductor (台达电子股份有限公司) (1 Invention)	Raytheon (1 Invention) EPC (1 Invention) Fujitsu (1 Invention) Toshiba (1 Invention)

Q1 2019 KEY FACTS Technical segment analysis

IP activity in the field of GaN Power & RF in Q1 2019

Q1 2019 KEY FACTS Re-assigned patents

RE-ASSIGNED PATENTS

Patent No.: US20160248753

RE-ASSIGNED PATENTS: Mixed semiconductor h-bridge power converters and methods related thereto

SEGMENT: Power applications, Circuitry & operating methods

Q1 2019 OVERVIEW Focus on main IP players of the quarter: Toshiba

TOSHIBA

IP activity in the field of GaN Power & RF in Q1 2019

Q1 2019 KEY FACTS

This quarter, the company has:
1 NEW PATENT APPLICATION
7 NEWLY GRANTED PATENTS
0 PATENT TRANSFER
2 DEAD PATENTS

- Toshiba was not very active during this quarter but obtained 7 new granted patents, mainly related to power applications. Newly granted patents address gate dielectric stack for GaN and SiC devices based on SiO₂ and AlON materials (US201901301), elaboration of AlGaN layers with high C/D ratio (US201901302), a normally-off device structure using a second gate electrode (US201901303), a power device layout structure with a reduced parasitic capacitance (US201901304) and a protection film for a power device which does not induce current collapse effects when a high drain voltage is applied (US201901305).
- Besides, Toshiba has abandoned a US patent (US20180100) granted since 2011 regarding the monolithic integration of a Si PIN diode in parallel with a GaN-based HEMT to provide a device with high avalanche capability and enhanced reliability.
- Regarding RF applications, Toshiba has abandoned the Taiwanese patent member of its family (US20150121) related to a high frequency circuit having a multi chip module structure. The family is still enforced in USA and Japan. In the meantime a new domestic patent was granted to Toshiba in Japan, related to a small-sized high-frequency semiconductor device having high power addition efficiency based on a distortion compensation circuit, a GaN amplifier and a GaN amplifier (US201901306). Furthermore, the only new patent application filed by Toshiba during the quarter is related to microwave device enhanced structure replacing the thick insulator layer below AlGaN barrier by multiple InGaAlN quantum wells to avoid carrier mobility degradation at the InGaAlN/AlGaN interface (US201901307).

PATENT MONITOR

Year-round access to an IP analyst

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Take advantage of **direct interaction with our analysts** by phone call and/or email for **result presentations, Q&A sessions, additional research** on specific technologies or companies' patent portfolios, and **customization of the monitoring service** by adding specific players and/or specific segments.

Examples of questions or requests:

- Could you tell me more about the **patent portfolio of this company**?
- What is exactly the **invention claimed** in these patents?
- Can you give me the **patents filed by this company** on these specific technologies?
- Can you shortly **analyze the patents** of this new entrant?
- What are the patents **issued in Japan and Korea** for this application?
- Please give me more details about this **patent litigation**.
- We want to file a new patent. Can you help us to **assess the prior-art** in this field?
- I would like to **invalidate these patents**. Could you do a prior-art search?
- Can you help me to identify in patents the **technical solutions** to solve this issue?
- I would like to assess my **freedom of operating** in USA. Can you provide me with the granted US patents covering this technology?
- I am looking for **free technologies** I could use safely without infringing valid IP rights. Can you provide me with newly expired patents related to this technology?
- I would like to **customize the monitoring service** to track my primary **competitor's IP activities**.
- I would like to **customize the monitoring service** to track patents related to a **specific topic**.



METHODOLOGY

Terminology (1/2)

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Patent Applicant, Patent Assignee

An applicant is a person or organization (e.g. company, university, etc.) who/which has filed a patent application. An assignee is a person or organization (e.g. company, university, etc.) who/which holds patent rights. There may be more than one applicant/assignee per patent application.

Patent Family

A patent family is a set of patents filed in multiple countries to protect a single invention by a common inventor(s). A first application is made in one country – the priority country – and is then extended to other countries.

Priority Date

The priority date is the date on which the patent application was filed. At this date the patent document is not made available to the public.

Priority Number

The priority number is the number of the application with respect to which priority is claimed, i.e. it is the same as the application number of the claimed priority document. The priority number is made up of a country code (two letters), the year of filing (four digits) and a serial number (variable, maximum seven digits).

Publication Date

The publication date is the date on which the patent application was first published. It is the date on which the patent document is made available to the public, thereby becoming part of the state of the art.

Publication Number

The publication number is the number assigned to a patent application on publication. Publication numbers are generally made up of a country code (two letters) and a serial number (variable, one to twelve digits) (e.g. DE202004009768).

International Patent Classification (IPC)

The technical content of patent documents is classified in accordance with the International Patent Classification (IPC). The publishing office assigns an IPC symbol valid at the time of publication of the patent application. The complete IPC can be found on the website of the World Intellectual Property Organization (WIPO - <https://www.wipo.int/ipcpub>).

Citations

In the context of patents, a citation is a reference to a previous work (prior art) that is considered relevant to the considered patent application. Citations may be made by the Inventor or by the Examiner during patent examination.

METHODOLOGY

Terminology (2/2)

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WO and EP Patent Applications

International (WO) and European (EP) Patent Applications are made through the World Intellectual Property Organization (WIPO) and the European Patent Office (EPO), respectively. WO applications designate signatory states or regions to the Patent Cooperation Treaty (PCT) and will have the same effect as national or regional patent applications in each designated state or region, leading to a granted patent in each state or region. EP applications are regional patent applications designating signatory state to the European Patent Convention (EPC) and leading to granted patents having the same effect as a bundle of national patents for the designated states.

Legal Status of the Patent

- **Pending:** Patent applications in a pre-grant/pre-final-rejection stage in the patent office.
- **Granted:** Patents in a "post-decision" or "post-grant" stage in the patent office.
- **Abandoned (Lapsed):** Patents or published applications that are not in force before the end of the normal term right because of applicant action or in-action. Normally this status refers to post-grant patents where the applicant has not paid the necessary renewal fees. However, "Lapsed" can include pre-grant published applications that are deemed likely abandoned because there has been no known activity in the office for a significant period of time. Typical office status for Lapsed could be "abandoned", "lapsed", "withdrawn", "surrendered", etc.
- **Expired:** Granted patents that have expired due to normal life of the patent cycle.
- **Rejected (Revoked):** Patents or published applications that are not in force before the end of the normal term right because of office action. Normally, this status refers to post-grant patents subject to opposition events. However, "Revoked" can include final rejection notices when we have that information from the office. Typical office status for "Revoked" could be "suspension", "interrupted", "cancelled", "revoked", "refused", etc.

Litigation Cases

"Litigation Cases" refers to filed actions. A single case filed may include multiple defendants. The date for a case filed is the date on which it was originally filed.

Litigation Campaign

"Litigation Campaign" refers to all cases filed by the same plaintiff (inclusive of all members in the corporate family) where each case has at least one patent or family member of a patent in common with another case in the campaign.

ITC (International Trade Commission) Investigation

The United States International Trade Commission (USITC) is an independent, quasi-judicial Federal agency with broad investigative responsibilities on matters of trade. **The Commission adjudicates cases involving imports that allegedly infringe intellectual property rights. A company can request an ITC investigation if they think that another company imports products which infringe their patents in USA .** Through such proceedings, the agency facilitates a rules-based international trading system. The Commission makes most of its information and analysis available to the public to promote understanding of international trade issues.

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KEY FACTS Q2 2021

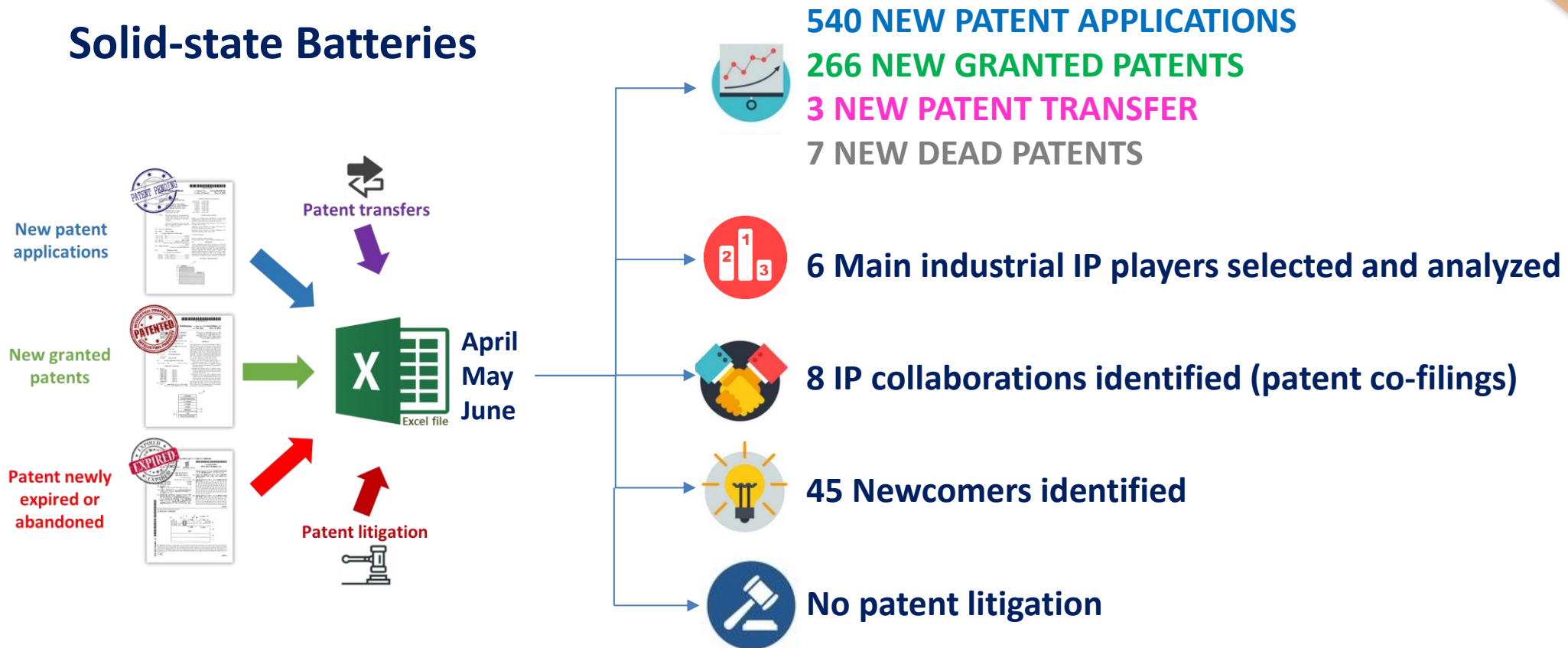




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Key facts of the quarter:

Solid-state Batteries





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KEY FACTS – Q2 2021

Supply chain vs. Solid electrolyte materials

The numbers represent the number of patent families. One patent family can belong to different segments.

	All segments		Electrolyte		Electrode		Battery cell		Battery pack		Separator	
	New application	New granted	New application	New granted	New application	New granted	New application	New granted	New application	New granted	New application	New granted
All segments	540	266	235	126	135	63	185	88	9	5	4	2
Inorganic	184	94	101	47	44	24	53	27		2		
Inorganic/ Polymer	154	62	91	41	35	15	31	10			3	
Polymer	78	60	35	37	20	9	26	16		1		1
List of materials	16	6	1		5	2	11	4				
Undefined solid electrolytes	107	42	6	1	31	13	64	28	9	2	1	
Sulfides (All)	97	42	66	25	13	6	29	11		1		
Argyrodites	19	13	19	13	2		4					
Sulfide glasses	28	13	24	9	3	3	1	1				
Thio-LISICON	1	4	1	4								
Other sulfides	4	2	4	2			1					
List of sulfides	46	18	19	4	8	3	23	11		1		
Oxide (all)	151	68	78	36	43	16	35	21			1	1
Oxide glass ceramics	2	2		1	1		1	1				
Anti-perovskites	2	5	2	3		2		1				
Perovskites	10	4	5	1	4	1	1	3				
LISICON	1				1							
Garnet	46	26	30	18	10	4	8	9				
NASICON	29	11	16	4	7	3	7	5			1	
Other oxides	18	9	14	8	4		1	1				
List of oxides	60	18	22	5	21	7	20	6				1
Hydrides		3		3								
Other inorganics	19	9	14	6	1	2	5	2				
List of inorganics	51	30	27	19	11	12	15	1			1	
Undefined inorganics	33	15	11	4	12	4	10	7		1	1	

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New patent applications (Q2 2021)

NEW PATENT APPLICATIONS (Q2 2021)

Overview (1/2)

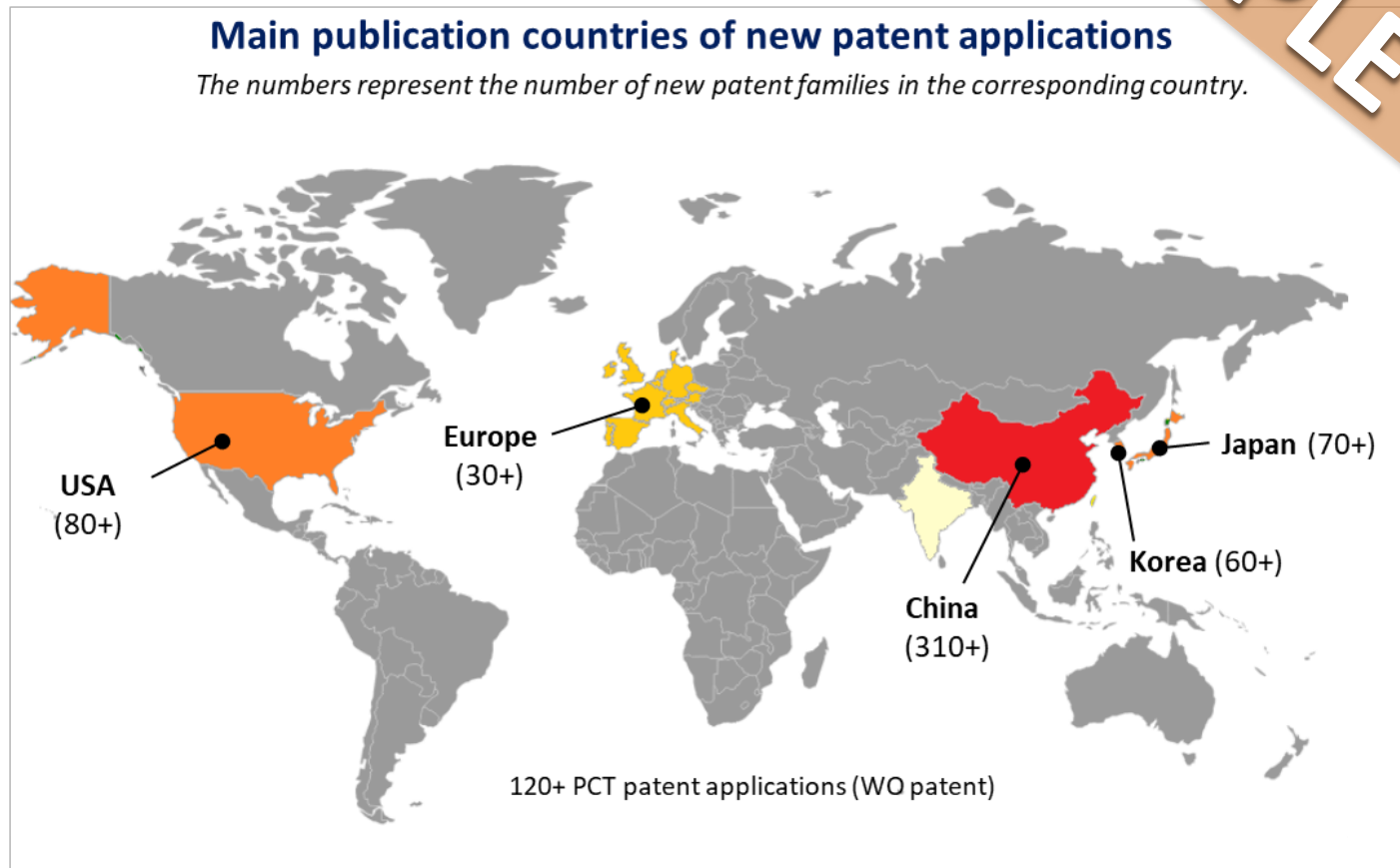


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- As previous [redacted] [redacted] [redacted] applications are mainly [redacted] [redacted] [redacted] of patent applicants [redacted] in Q2 2021, [redacted] from China, especially [redacted] [redacted] [redacted] and material [redacted].
- There is also [redacted] [redacted] [redacted] in **Japan** (the former [redacted] [redacted] [redacted]), Korea and the US [redacted] [redacted] [redacted] from Japan still [redacted] [redacted] [redacted] solid-state battery (T [redacted] [redacted] [redacted] etc.). Most of Japanese [redacted] [redacted] [redacted] are material [redacted].
- Despite a [redacted] [redacted] [redacted] players in Q2 2021, [redacted] [redacted] [redacted] new patent families filed [redacted] [redacted] [redacted] activity of major battery [redacted] [redacted] [redacted] **LG Energy Solution** and [redacted] [redacted] [redacted] players in Q2 2021 are [redacted].
- As expected [redacted] [redacted] [redacted] is continuously increasing [redacted] [redacted] [redacted] an area of interest for [redacted] [redacted] [redacted] field driven by the growing [redacted] [redacted] [redacted] [redacted] [redacted].

Main publication countries of new patent applications

The numbers represent the number of new patent families in the corresponding country.



NEW PATENT APPLICATIONS (Q2 2021)

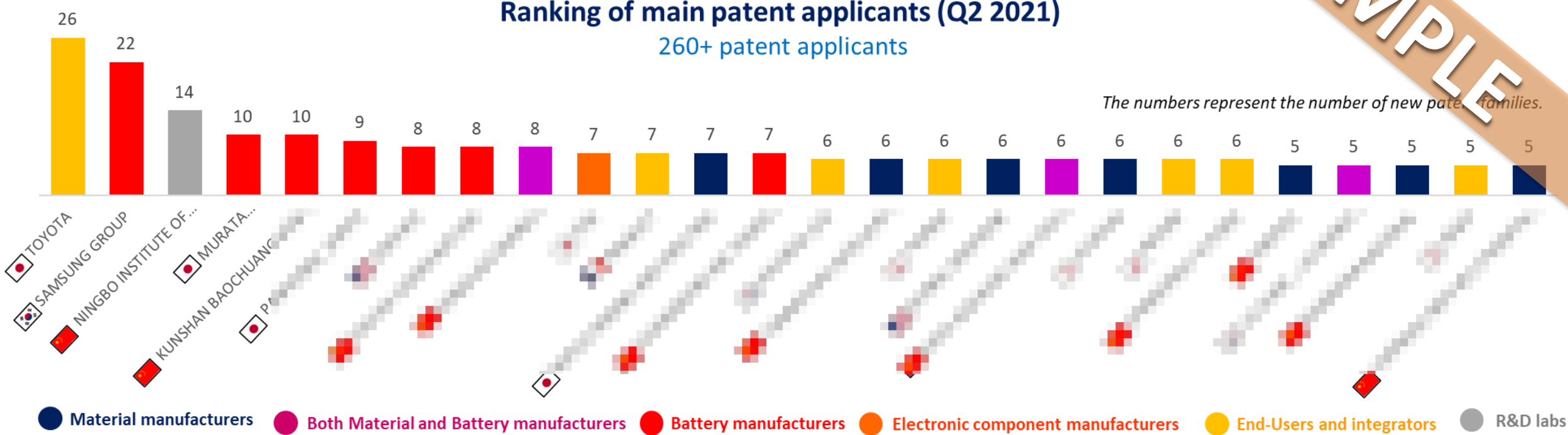
Overview (2/2)



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Ranking of main patent applicants (Q2 2021)

260+ patent applicants



The numbers represent the number of new patent families.

- More than 200 patent families were filed in Q2 2021.
- Toyota, the largest manufacturer founded in 1937, filed 26 patent families, including Silicon anodes.
- There are 10 battery manufacturers in the top 20, including FAW, BAIC, BMW, SAIC, Skoda). It filed 10 patent families.
- There are 10 end-users and integrators in the top 20, including Mitsumi (3), Hitachi Maxell (3), erloo (2), FAW (2), Solvay (2), BYD (2), GS Yuasa (1), Huawei (1), Saft/Total (1), JX Holdings (1), Sekisui Chemical (1).

NEW PATENT APPLICATIONS (Q2 2021)

Main patent applicants vs. Technical segments



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The numbers represent the number of patent families. One patent family can belong to different segments.

	Nb of patent families	Electrolyte	Electrode	Battery cell	Battery pack	Separator	Inorganic	Inorganic/Polymer	Polymer	List of materials	Undefined solid electrolytes	Sulfides (All)	Argyrodites	Sulfide glasses	Thio-LISICON	Other sulfides	List of sulfides	Oxide (all)	Oxide glass ceramics	Anti-perovskites	Perovskites	LISICON	Garnet	NASICON	Other oxides	List of oxides	Hydrides	Other	Organics	Undefined inorganics
All Players	540	235	135	185	9	4	184	154	78	16	107	97	19	28	1	4	46	151	2	2	10	1	46	29	18	60		19	5	
[Redacted]		6	7	10	3		8	5			13	8		1			7	5					3		2		1			
[Redacted]		11	2	15			20	1		1		9	3		3	3	12	1				2	3	3	5		4	3		
[Redacted]		12	3					14				10		7			3	1					1					3		
[Redacted]				10							10																			
[Redacted]		2	5	4			2	6	2									7					1		6			1		
[Redacted]		3		6			5				4							2		1				1		1	2			
[Redacted]		2	1	6				4	1	3								2							2		2			
ZUHAI COSMX BATTERY	8	5		3				5	2		1							2							2		3			
FENGCHAO ENERGY TECHNOLOGY	8	3	4	1				4	1		3	1				1	1								1		2			
TDK	7	6		1			3				4							3			1		2							
RENAULT	7		1	5	1		3			1	3	3					3													
[Redacted]		6	2				7					5	6															1		
[Redacted]		3	1	2		1	1	2	2		2							1					1			1	1			
[Redacted]			1	5				2			4																	2		
[Redacted]		2	3	1			2	2	1		1	1				1	1								1		2			
[Redacted]			3	1	2	1	1				5							1							1					
[Redacted]		1	4	1				3	3			1					1								1		2			
[Redacted]		2	3	1			2	3	1									3				1	2		1	1	1			
[Redacted]		5		4			1	5				5					5										1			
[Redacted]			1	4	1		3				3	3					3													
[Redacted]		5	1					4	2									2							2		1	1		
[Redacted]			5				1		4									1				1								
[Redacted]		1	3	1			1	4				1				1										3	1			
[Redacted]			5								5																			
[Redacted]		2	3				5											5				4		1						
[Redacted]		5						3	2									2			1	2					1			



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NEW PATENT APPLICATIONS (Q2 2021)

Newcomers in solid-state battery patent landscape

• In Q2 2021, there are 30+ newcomers in solid-state battery patent landscape. Most of them are Chinese companies or R&D labs.

COMPANY	WEBSITE	PATENT NUMBER	COMMENTS
EcoPro	https://www.ecoprobm.co.kr/eng/sub020101	WO202175940	<ul style="list-style-type: none"> EcoPro is a Korean battery material manufacturer. Its patent on solid-state battery is related to a layered cathode material containing inorganic solid electrolyte.
[Blurred]	[Blurred]	[Blurred]	[Blurred] containing polymer or inorganic-polymer electrolytes.
[Blurred]	[Blurred]	[Blurred]	[Blurred]
[Blurred]	[Blurred]	[Blurred]	[Blurred] and its preparation method and application.
[Blurred]	[Blurred]	[Blurred]	[Blurred] at is a developer of nanolayer coating technology for solid-state electrolytes
[Blurred]	[Blurred]	[Blurred]	[Blurred] components.
Global Battery	gybc.tradekorea.com	[Blurred]	[Blurred] d electrolyte having sulfonated aluminium oxide and [Blurred]

NEW PATENT APPLICATIONS (Q2 2021)

Main IP collaborations



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This table shows main new collaborations involving industrial applicants. It highlights the collaborations with industrial players that have led to patent co-filing.

Co-assignees		Number of common patent families	Representative members of patent families	Topic of patent families	Comments
BASF	[REDACTED]	2	[REDACTED]	[REDACTED] synthesis method	BASF of [REDACTED] company
Honda	[REDACTED]	2	[REDACTED]	[REDACTED] lithium ion	Su [REDACTED] of
Hyundai/Kia	[REDACTED]	1	[REDACTED]	[REDACTED]	Ir [REDACTED] in
Kaneka	[REDACTED]	1	[REDACTED]	[REDACTED] for	Kan [REDACTED] research
[REDACTED]	Renault	6	[REDACTED]	[REDACTED] refined solid [REDACTED] active	Ren [REDACTED] since
[REDACTED]	Georgia Tech	1	[REDACTED]	[REDACTED]	Sil [REDACTED] co-f [REDACTED] Sci [REDACTED]
[REDACTED]	Vs Chemicko Technologicka V Praze	1	[REDACTED]	[REDACTED] materials,	In 20 [REDACTED] Pra [REDACTED] on
[REDACTED]	Denso / Soken	2	[REDACTED]	[REDACTED] battery, all-solid- [REDACTED] od for	Sir [REDACTED] en



NEW PATENT APPLICATIONS (Q2 2021)

Production chain position vs. Electrolyte materials (1/5)

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	All segments	Electrolyte	Electrode	Battery cell	Battery pack	Separator
All segments	540	235	135	185	9	4
Inorganic	184	101	44	53		
Inorganic/ Polymer	154	91	35	31		3
Polymer	78	35	20	26		
List of materials	16	1	5	11		
Undefined solid electrolytes	107	6	31	64	9	1
Sulfides (All)	97	66	13	29		
Argyrodites	19	19	2	4		
Sulfide Glass Ceramics	28	24	3	1		
Thio-LISICON	1	1				
Other sulfides	4	4		1		
List of sulfides	46	19	8	23		
Oxide (all)	151	78	43	35		1
Oxide Glass Ceramics	2		1	1		
Anti-perovskites	2	2				
Perovskites	10	5	4	1		
LISICON	1		1			
Garnet	46	30	10	8		
NASICON	29	16	7	7		1
Other oxides	18	14	4	1		
List of oxides	60	22	21	20		
Hydrides						
Other inorganics	19	14	1	5		
List of inorganics	51	27	11	15		1
Undefined inorganics	33	11	12	10		1

The numbers represent the number of patent families. One patent family can belong to different segments.

- New **Batteries** and **Batteries**...
- New **inorganic** electrolyte materials, including **NASICON** and **fluoride**...
- New **organic** electrolyte materials, including **polymer** and **solid** electrolytes...
- **Garnet** materials and **Hydrides**...
- **Sulfide** materials...



SAMPLE

NEW PATENT APPLICATIONS (Q2 2021)

Production chain position vs. Electrolyte materials (3/5)

	All segments	Electrolyte	Electrode	Battery cell	Battery pack	Separator
All segments	-	Ningbo (6)				g Mic (1), jiang
Sulfides (All)	Ningbo (10), Mitsuba (8), Fujifilm	Ningbo Techno, Mitsuba, Fujifilm		film (4), ota (3), screen	-	-
Argyrodites	Mitsuba, Sam (3), Gs (1)	Mitsuba (3), Sam (1), Gs (1)		ip (1)	-	-
Sulfide glasses	Ningbo (2), Shantou (2), Ganfen Energy	Ningbo (2), Shantou, Ganfen (2), Toy		.	-	-
Thio-LISICON	Uni Bamo	Univ			-	-
Other sulfides	1)	Sam			-	-
List of sulfides	Tc (3), Sam, Indu (3), wa (3)	Fujifilm, Industri, Idemi, Qingc, Bioprc		Toyota, Screen, nsung, cellent	-	-

The numbers represent the number of patent families. One patent family can belong to different segments.



SAMPLE

NEW PATENT APPLICATIONS (Q2 2021)

Production chain position vs. Electrolyte materials (4/5)

	All segments	Electrolyte	Electrode	Battery cell	Separator
All segments	-	Ningbo (11), Td Smelti			
Oxide (all)	Samsu chuang New ta (5),	Samsu Tec Kuns			
Oxide glass ceramics	All Play Ngk (1)				
Anti-perovskites	Panas science	Panas			
Perovskites	Tdk (iv. (1), Toho T Power	Toho Batter Keli C			
LISICON	Hefei G energy (1)				
Garnet	Seiko up (2),	Toy Che Elec			
NASICON	San ngqi Chuan High T of Washi Mat. (1)	Tdk (2 Dow: Samst			

The numbers represent the number of patent families. One patent family can belong to different segments.

SAMPLE

New granted patents (Q2 2021)

NEW GRANTED PATENTS (Q2 2021)

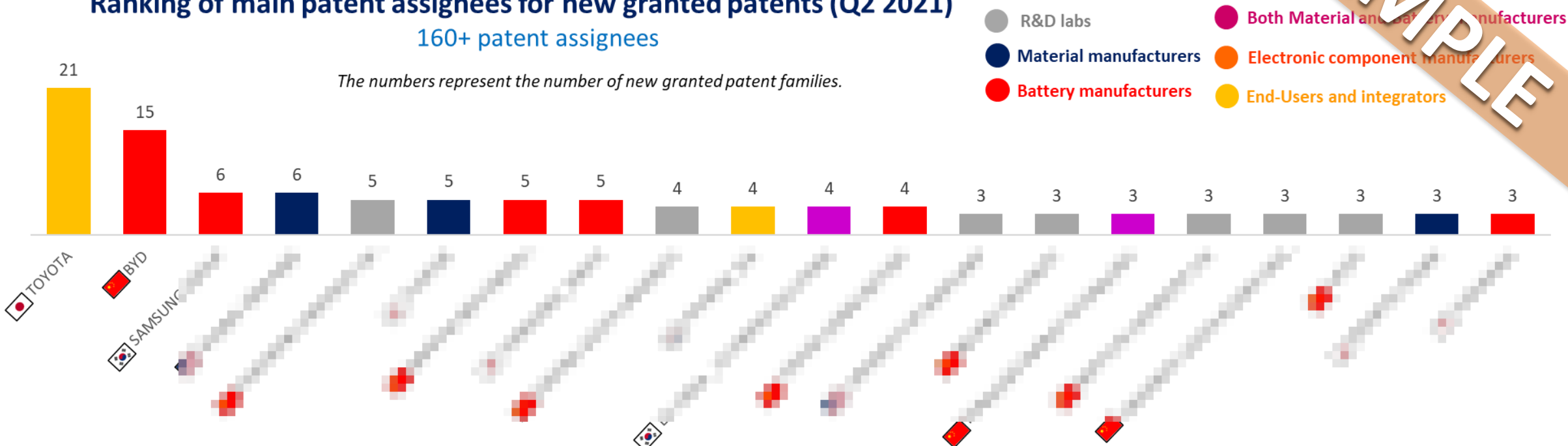
Main patent assignees

SAMPLE

Ranking of main patent assignees for new granted patents (Q2 2021)

160+ patent assignees

The numbers represent the number of new granted patent families.



- More [blurred]
- There [blurred] (2), Mitsui Mining & Smelt [blurred] (2), Mitsui Mining & Smelt [blurred] (1), Mitsui Kasei (1), Mitsubishi [blurred]
- Among [blurred]
 - Pro [blurred]
 - Ter [blurred]
 - Qin [blurred]
 - Qu [blurred]
 - En [blurred]

NEW GRANTED PATENTS (Q2 2021)

Main patent assignees vs. Technical segments

SAMPLE

The numbers represent the number of patent families. One patent family can belong to different segments.

	Nb of patent families	Electrolyte	Electrode	Battery cell	Battery pack	Separator	Inorganic	Inorganic/Polymer	Polymer	List of materials	Undefined solid electrolytes	Sulfides (All)	Argyrodites	Sulfide glasses	Thio-LISICON	Other sulfides	List of sulfides	Oxide (all)	Oxide Glass ceramics	Anti-perovskites	Perovskites	LISICON	Garnet	NASICON	Other oxides	List of oxides	Hydrides	Other materials	List of inorganics	Undefined inorganics
All Players	266	126	63	88	5	2	94	62	60	6	42	42	13	13	4	2	18	68	2	5	4		26	11	9	18	3	9	30	15
		6	4	12			11			1	7	8		1	3		5	2					1		1					3
		11	2	5			4	4	6		1	2					2	4							4		1	3		
		4	1	1			1	1	2		2	1	1															1		
			4	2				3	2	1																		3		
		4		2				2	3									2					1		1					
FUJIFILM	5	3	1	1		1	2	3	1			3	1				2									1		1	2	
QINGTAO NEW ENERGY TECH.	5	2	2		1		1	3			1							2					2					1	1	
				5	2		3				2	2					2												1	
		2	1	1			2	1			1	1		1				1					1				1			
		3		1			3		1			3	2	2																
			2	2		1	1	2										2							2			1	1	
		2	1	2			2	1				1					1	2		1					1			1		
		1	2	1			2	1										2						1	1			1		
		2		1				1	1		1																1			
		3		2			1	1	1																		1	1		
		1	2						1		2																			
		2		1			1	1			1							1					1					1		
		2	1				2	1	1									2		1			1							
		1		2			2	1										3			2		2		1					
		3					3					3	2	2			1													
		1	2				3					2		1			1										1			



SAMPLE

NEW GRANTED PATENTS (Q2 2021)

Production chain position vs. Electrolyte materials (1/5)

	All segments	Electrolyte	Electrode	Battery cell	Battery pack	Separator
All segments	266	126	63	88	5	2
Inorganic	94	47	24	27	2	
Inorganic/ Polymer	62	41	15	10		
Polymer	60	37	9	16	1	1
List of materials	6		2	4		
Undefined solid electrolytes	42	1	13	28	2	
Sulfides (All)	42	25	6	11	1	
Argyrodites	13	13				
Sulfide glasses	13	9	3	1		
Thio-LISICON	4	4				
Other sulfides	2	2				
List of sulfides	18	4	3	11	1	
Oxide (all)	68	36	16	21		1
Oxide glass ceramics	2	1		1		
Anti-perovskites	5	3	2	1		
Perovskites	4	1	1	3		
LISICON						
Garnet	26	18	4	9		
NASICON	11	4	3	5		
Other oxides	9	8		1		
List of oxides	18	5	7	6		1
Hydrides	3	3				
Other inorganics	9	6	2	2		
List of inorganics	30	19	12	1		
Undefined inorganics	15	4	4	7	1	

The numbers represent the number of patent families. One patent family can belong to different segments.

- Newly granted patents are mostly related to **electrolyte** and **Battery cell**. There are only few new granted patents related to **Battery pack** technologies.
- New granted patents are mostly related to **inorganic solid electrolyte** and **inorganic/polymer solid electrolytes**, notably **oxide** and **thio-LISICON**.
- Newly granted patents on **polymer** and **inorganic/polymer electrolyte** are almost exclusively related to **electrolyte material**. For the battery, newly granted patents on **inorganic electrode** and **battery cell** materials are related to **electrode** and **battery cell** materials. There are also patents on **electrode** and **battery cell** materials related to **solid electrolyte**. There are also patents on **separator** and **Battery cell** materials related to **inorganic** and **inorganic/polymer solid electrolytes** mainly materials related to **solid electrolyte** materials.
- **Garnet, Anti-perovskites** and **Perovskites** are the main inorganic materials related to newly granted patents.

NEW GRANTED PATENTS (Q2 2021)

Production chain position vs. Electrolyte materials (3/5)

The numbers represent the number of patent families.
One patent family can belong to different segments.



SAMPLE

	All segments	Electrolyte	Electrode	Battery cell	Battery pack	Separator
All segments	-	Byd Group, Sci, Hyunda				
Sulfides (All)	T, Hany, lo	To, Hany, Kosa, Central				
Argyrodites	Hyur, Iden	Hyund, Idemits, Tianmu				
Sulfide glasses	Hyur, Iden, Uni, An	Hyunda, South, Exc, M				
Thio-LISICON	Toyo, Zheji, Hang	Toy, Techn, Power				
Other sulfides	Her, Zheji, Hang	Heng, Zhejia, Hangzh				
List of sulfides	Toyo, Par, Kosa	Toyota				

NEW GRANTED PATENTS (Q2 2021)

Production chain position vs. Electrolyte materials (4/5)

The numbers represent the number of patent families.
One patent family can belong to different segments.



SAMPLE

	All segments	Electrolyte	Electrode	Battery cell	Battery pack	Separator
All segments	-	All Patents (126)	All Patents (62)	All Patents (88)	All Patents (5)	All Patents (2)
Oxide (all)	Byd [redacted] City Of [redacted] Maryl [redacted] zhong [redacted] U [redacted] and [redacted] Te [redacted] (2)	Byd [redacted] Group [redacted] Sc [redacted] Hyund [redacted]	[redacted]	[redacted]	[redacted]	[redacted] Lg [redacted]
Oxide glass ceramics	Al [redacted] (1)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Anti-perovskites	Zhen [redacted] nome [redacted] ute (1), [redacted] South [redacted] ents (1), [redacted] Uni [redacted] And [redacted] Tech [redacted] t Wall [redacted] Motor [redacted] tery (1)	Zhe [redacted] Engi [redacted] Sout [redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Perovskites	Uestc [redacted] ity (1), [redacted] Zhen [redacted] nome [redacted] t. (1)	Zhe [redacted] Engi [redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Garnet	Seik [redacted] nergy [redacted] Te [redacted] ng [redacted] Univer [redacted] zhong [redacted] U [redacted] and [redacted] Tech [redacted] spring [redacted] l)	Seik [redacted] Huaz [redacted] Tec [redacted] Mate [redacted] Sc [redacted] Ma [redacted] Mat [redacted]	[redacted]	[redacted]	[redacted]	[redacted]

SAMPLE

New dead patents (Q2 2021)




SAMPLE

NEW DEAD PATENTS (Q2 2021)

Most notable dead patents (selected by Knowmade IP analyst)

Assignee	Publication number	STATUS	TOPIC OF THE PATENT
Toray Industries (acquired from LG Chem in 2017)	[REDACTED]	Expired	[REDACTED]
Blue Solutions / Johnson Matthey (acquired from Clariant/Phostech Lithium in 2015)	[REDACTED]	Lapsed	[REDACTED] having
Dai Nippon Screen Manufacturing	[REDACTED]	Lapsed	[REDACTED]
Kyushu University / NGK Insulators	[REDACTED]	Lapsed	[REDACTED]
NOF	[REDACTED]	Expired	Polyme [REDACTED] production of
Sumitomo Electric Industries	[REDACTED]	Expired	Negativ [REDACTED] electrolytic
Toyota Motor	[REDACTED]	Expired	N [REDACTED] tery

 [USXXXXXX](#) Click to link full text documents

Notable patents were selected on the basis of their citations, family size, patented technology, and impact in the field.



If a patent is dead (expired or abandoned), is it possible to make the formerly patented product?

An expired patent cannot be asserted against competitors. However, other live patents may still cover different parts, features or combinations described in the expired patent. Moreover, in some countries, a lapsed patent can be reinstated/restored by paying an additional fee plus the maintenance fee, and reasoning that delay or nonpayment of the maintenance fee within the prescribed period was unintentional.

SAMPLE

New patent transfer (Q2 2021)



NEW PATENT TRANSFER (Q2 2021)

From Lionano to Factorial

SAMPLE



Patents transferred in Q2 2021



Lionano was founded in 2015 by Yu Huang and is headquartered in San Jose, California.

Lionano is developing an advanced drop-in replacement for lithium-ion batteries. The company focuses on producing high-performance lithium-ion batteries. The materials used in the batteries have greater capacity and lower cost. The technology is currently being tested for consumer electronics.

Factorial was founded in 2015 by the same founder as Lionano and is headquartered in Boston, Massachusetts.

Factorial develops solid-state batteries. The company has yielded a solid-state battery with a performance profile that is the world's largest and most advanced solid-state battery. The technology is currently being tested for its performance in consumer electronics.

Patents involved in the transfer

[US Patent](#) [redacted]

[US Patent](#) [redacted] forming method thereof, and battery

[US Patent](#) [redacted] the same

SAMPLE

FOCUS ON MAIN IP PLAYERS OF Q2 2021



FOCUS ON MAIN IP PLAYERS – Q2 2021

TOYOTA - Overview



SAMPLE

This quarter, Toyota has:
26 NEW PATENT APPLICATIONS
21 NEWLY GRANTED PATENTS
0 PATENT TRANSFERS
1 DEAD PATENT

The numbers represent the number of patent families. One patent family can belong to different segments.

	All segments		Electrolyte		Electrode		Battery cell		Battery pack	
	New application	New granted	New application	New granted	New application	New granted	New application	New granted	New application	New granted
All segments	26	21	6	6	7	4	10	12	3	
Inorganic	8	11	4	5	2	1	2	5		
Inorganic/ Polymer	5		2		1		2			
Polymer										
List of materials		1						1		
Undefined solid electrolytes	13	7			4	3	6	4	3	
Sulfides (All)	8	8	3	4	2		3	4		
Argyrodites										
Sulfide glasses	1	1	1					1		
Thio-LISICON		3		3						
Other sulfides										
List of sulfides	7	5	2	1	2		3	4		
Oxide (all)	5	2	3	2	1		1	1		
Oxide glass ceramics										
Anti-perovskites										
Perovskites										
LISICON										
Garnet	3	1	2	1	1			1		
NASICON										
Other oxides		1		1						
List of oxides	2		1				1			
Hydrides										
Other inorganics	1		1							
List of inorganics										
Undefined inorganics	1	3				1	1	2		

- Toyota published a high number of newly published patent families, a number of newly granted patents that it keeps in the field of solid-state batteries.
- New patent families granted patent families of Toyota are mainly related to sulfide electrolytes, both sulfide electrolytes and solid electrolytes. Ceramic glass ceramic electrolytes are also patent applications for solid electrolytes. New patent families are a strategic move of Toyota.
- New patent families are related to electrolyte concept separation.

FOCUS ON MAIN IP PLAYERS – Q2 2021

TOYOTA - Notable patents selected by Knowmade analyst



SAMPLE

PATENT NUMBER	TYPE	TOPIC OF THE PATENT	PATENT DETAILS
JP	NEW GRANTED PATENT	Batte All-so	An all-so positive e active m surface c second r the elast
US	NEW GRANTED PATENT	Batte sulfid All-so	An all-so has high layer dis contains a sulfide solid ele percenta
US2	NEW PATENT PUBLICATION	Elect Garne meth	Provided The garn one surf and a de from the
JP2	NEW PATENT PUBLICATION (Co-filed Denso / Soken)	Elect Othe Solid same	A solid e compou medium Advanta maintain
US2	NEW PATENT PUBLICATION	Elect sulfid Slurry produ	A main resistivit and the crystalliz solvent, solid elec

[USXXXXXX](#) Clickable link to pdf document

Notable patents were selected on the basis of their technical interest, citations received from other patents, family size, current legal status, scope of the claims, and impact in the field.

FOCUS ON MAIN IP PLAYERS – Q2 2021

SAMSUNG - Overview



SAMPLE



Abstract: This document describes a solid-state battery system and method of manufacturing the same. The system includes a solid-state electrolyte layer, a positive electrode, and a negative electrode. The positive electrode is formed on one surface of the solid-state electrolyte layer, and the negative electrode is formed on the other surface. The positive electrode includes a positive electrode active material layer and a positive electrode current collector layer. The negative electrode includes a negative electrode active material layer and a negative electrode current collector layer. The solid-state electrolyte layer is formed on a substrate. The positive electrode active material layer is formed on the positive electrode current collector layer. The negative electrode active material layer is formed on the negative electrode current collector layer. The positive electrode current collector layer and the negative electrode current collector layer are formed on the solid-state electrolyte layer. The positive electrode current collector layer and the negative electrode current collector layer are formed on the solid-state electrolyte layer. The positive electrode current collector layer and the negative electrode current collector layer are formed on the solid-state electrolyte layer.

FOCUS ON MAIN IP PLAYERS – Q2 2021

SAMSUNG - Notable patents selected by Knowmade analyst



SAMPLE

Patent No.	Title	Abstract	Claims
USXXXXXX	Method for controlling a solid-state battery	A method for controlling a solid-state battery, including: receiving a control signal; determining a state of charge of the solid-state battery; and controlling the solid-state battery based on the state of charge and the control signal.	1. A method for controlling a solid-state battery, comprising: receiving a control signal; determining a state of charge of the solid-state battery; and controlling the solid-state battery based on the state of charge and the control signal.
USXXXXXX	Method for manufacturing a solid-state battery	A method for manufacturing a solid-state battery, including: providing a solid-state electrolyte; providing a positive electrode; providing a negative electrode; and assembling the solid-state battery.	1. A method for manufacturing a solid-state battery, comprising: providing a solid-state electrolyte; providing a positive electrode; providing a negative electrode; and assembling the solid-state battery.
USXXXXXX	Method for charging a solid-state battery	A method for charging a solid-state battery, including: determining a state of charge of the solid-state battery; and charging the solid-state battery based on the state of charge.	1. A method for charging a solid-state battery, comprising: determining a state of charge of the solid-state battery; and charging the solid-state battery based on the state of charge.
USXXXXXX	Method for discharging a solid-state battery	A method for discharging a solid-state battery, including: determining a state of charge of the solid-state battery; and discharging the solid-state battery based on the state of charge.	1. A method for discharging a solid-state battery, comprising: determining a state of charge of the solid-state battery; and discharging the solid-state battery based on the state of charge.
USXXXXXX	Method for monitoring a solid-state battery	A method for monitoring a solid-state battery, including: monitoring a state of charge of the solid-state battery; and monitoring a temperature of the solid-state battery.	1. A method for monitoring a solid-state battery, comprising: monitoring a state of charge of the solid-state battery; and monitoring a temperature of the solid-state battery.

[USXXXXXX](#) Clickable link to pdf document

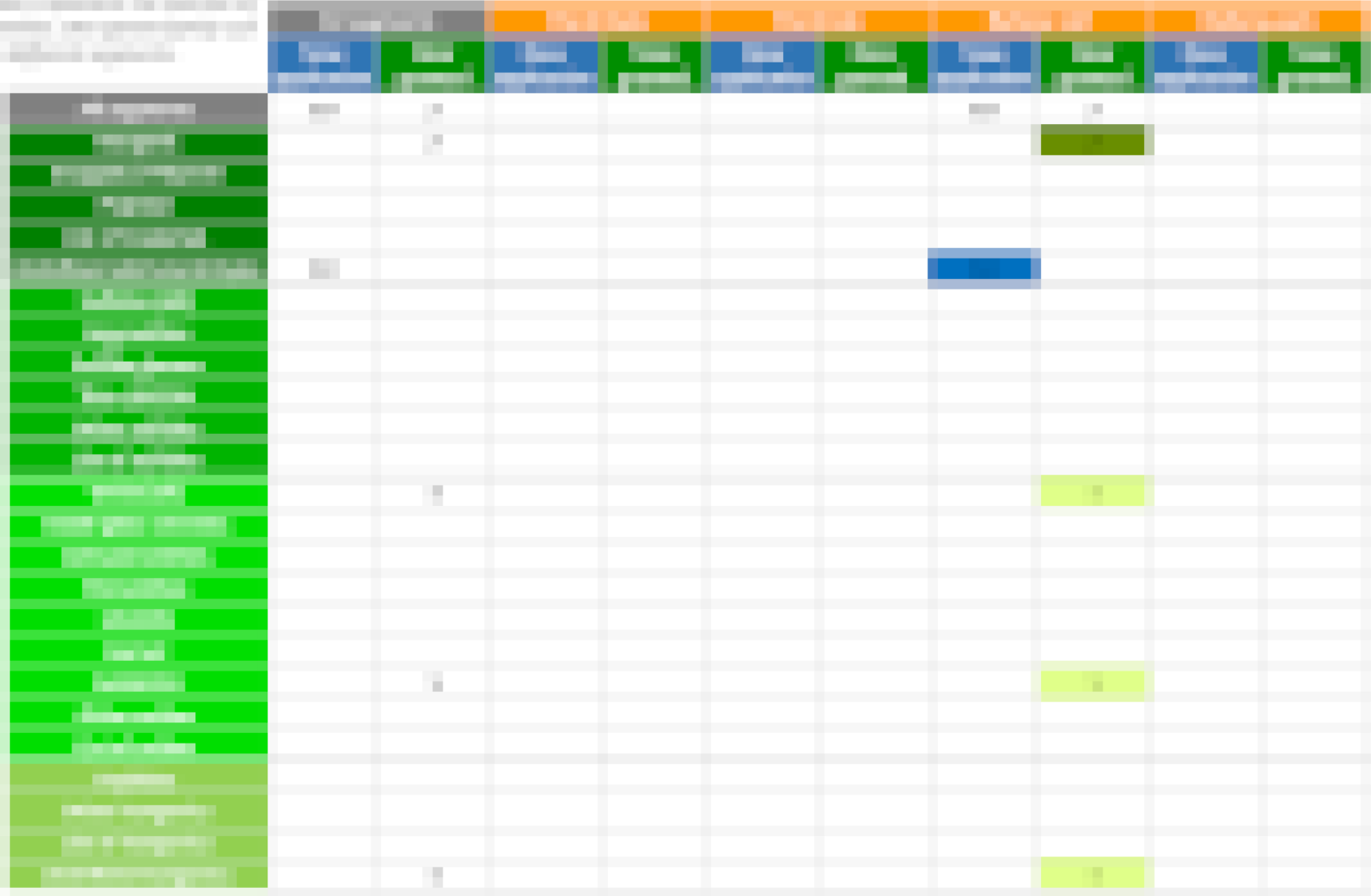
Notable patents were selected on the basis of their technical interest, citations received from other patents, family size, current legal status, scope of the claims, and impact in the field.

FOCUS ON MAIN IP PLAYERS – Q2 2021

MURATA / SONY - Overview



SAMPLE



Summary of patent activity for Murata and Sony in Q2 2021. The chart shows a significant number of patents filed, particularly in the early part of the quarter. The data is categorized by technology area and geographic region.

FOCUS ON MAIN IP PLAYERS – Q2 2021

MURATA / SONY - Notable patents selected by Knowmade analyst



SAMPLE

Patent No.	IPC Class.	Patent Title	Abstract
USXXXXXX	H01M 10/42	Method for manufacturing a solid-state battery	The present invention relates to a solid-state battery and a method for manufacturing the same. The solid-state battery includes a solid electrolyte layer, a positive electrode layer, and a negative electrode layer. The method includes steps of forming the solid electrolyte layer, the positive electrode layer, and the negative electrode layer.
USXXXXXX	H01M 10/42	Method for manufacturing a solid-state battery	The present invention relates to a solid-state battery and a method for manufacturing the same. The solid-state battery includes a solid electrolyte layer, a positive electrode layer, and a negative electrode layer. The method includes steps of forming the solid electrolyte layer, the positive electrode layer, and the negative electrode layer.
USXXXXXX	H01M 10/42	Method for manufacturing a solid-state battery	The present invention relates to a solid-state battery and a method for manufacturing the same. The solid-state battery includes a solid electrolyte layer, a positive electrode layer, and a negative electrode layer. The method includes steps of forming the solid electrolyte layer, the positive electrode layer, and the negative electrode layer.
USXXXXXX	H01M 10/42	Method for manufacturing a solid-state battery	The present invention relates to a solid-state battery and a method for manufacturing the same. The solid-state battery includes a solid electrolyte layer, a positive electrode layer, and a negative electrode layer. The method includes steps of forming the solid electrolyte layer, the positive electrode layer, and the negative electrode layer.

[USXXXXXX](#) Clickable link to pdf document

Notable patents were selected on the basis of their technical interest, citations received from other patents, family size, current legal status, scope of the claims, and impact in the field.

FOCUS ON MAIN IP PLAYERS – Q2 2021

PANASONIC / SANYO - Overview

SAMPLE

IP	2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

1. Introduction

2. Market Overview

3. Key Players

4. Patent Landscape

5. Competitive Analysis

6. Future Outlook

7. Conclusion

FOCUS ON MAIN IP PLAYERS – Q2 2021

PANASONIC / SANYO - Notable patents selected by Knowmade analyst



SAMPLE

Patent No.	Applicant	Inventor	Abstract
USXXXXXX	PANASONIC	XXXXXXXXXX	...
USXXXXXX	PANASONIC	XXXXXXXXXX	...
USXXXXXX	PANASONIC	XXXXXXXXXX	...
USXXXXXX	PANASONIC	XXXXXXXXXX	...
USXXXXXX	PANASONIC	XXXXXXXXXX	...

[USXXXXXX](#) Clickable link to pdf document

Notable patents were selected on the basis of their technical interest, citations received from other patents, family size, current legal status, scope of the claims, and impact in the field.

FOCUS ON MAIN IP PLAYERS – Q2 2021

ENEVATE - Overview

SAMPLE

ENEVATE is a leading provider of...
The company's focus is on...
Key players in the market include...
The market is expected to grow...
Key challenges include...
The company's strategy is to...
Key players in the market include...
The market is expected to grow...
Key challenges include...

FOCUS ON MAIN IP PLAYERS – Q2 2021

ENEVATE - Notable patents selected by Knowmade analyst

SAMPLE

Patent No.	IPC Class.	Patent Title	Abstract
USXXXXXX	H01M 10/052	Method for manufacturing a solid-state battery	Disclosed is a method for manufacturing a solid-state battery. The method includes: providing a solid-state electrolyte; providing a positive electrode; providing a negative electrode; and assembling the solid-state battery.
USXXXXXX	H01M 10/052	Method for manufacturing a solid-state battery	Disclosed is a method for manufacturing a solid-state battery. The method includes: providing a solid-state electrolyte; providing a positive electrode; providing a negative electrode; and assembling the solid-state battery.
USXXXXXX	H01M 10/052	Method for manufacturing a solid-state battery	Disclosed is a method for manufacturing a solid-state battery. The method includes: providing a solid-state electrolyte; providing a positive electrode; providing a negative electrode; and assembling the solid-state battery.
USXXXXXX	H01M 10/052	Method for manufacturing a solid-state battery	Disclosed is a method for manufacturing a solid-state battery. The method includes: providing a solid-state electrolyte; providing a positive electrode; providing a negative electrode; and assembling the solid-state battery.

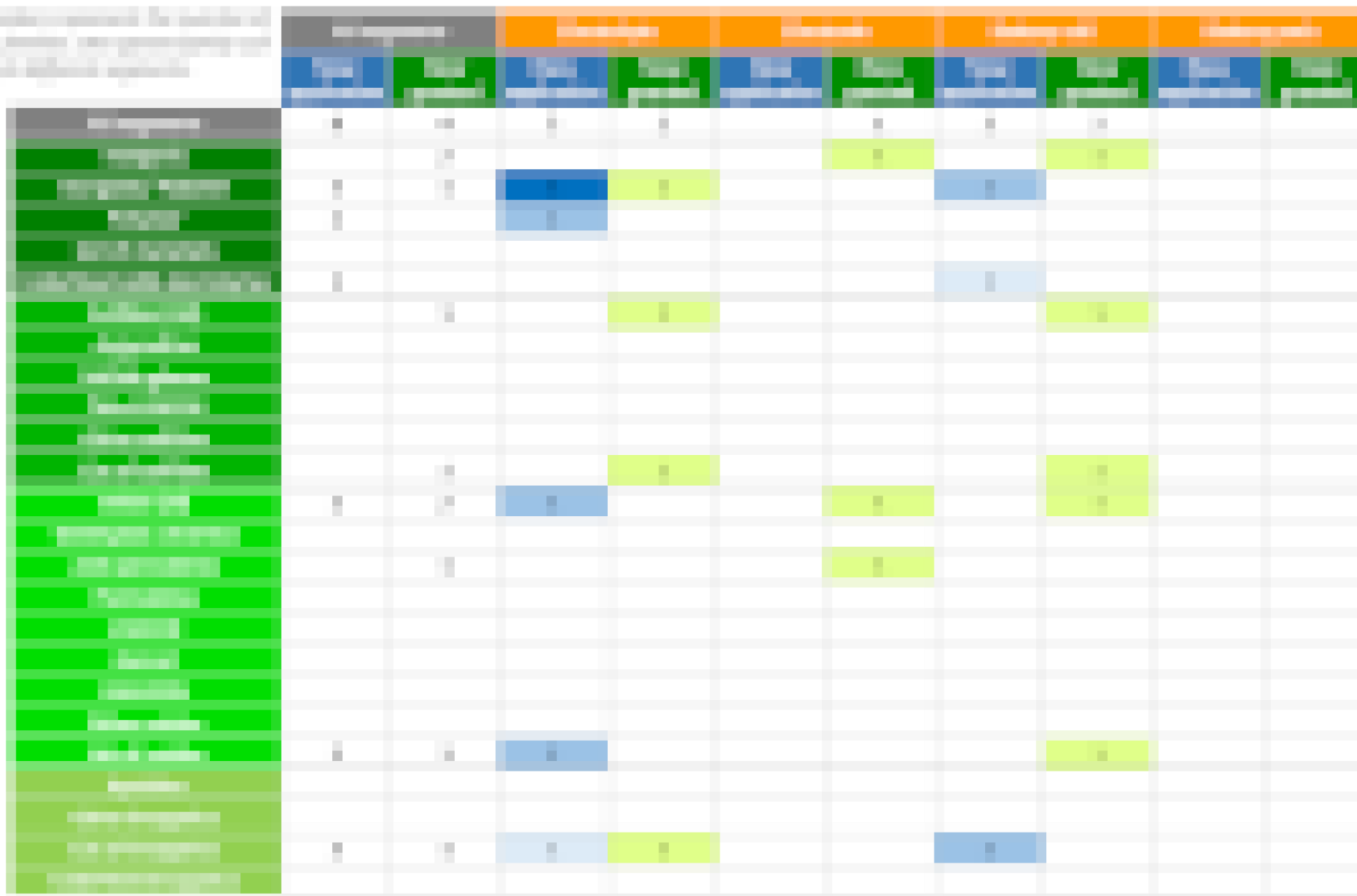
[USXXXXXX](#) Clickable link to pdf document

Notable patents were selected on the basis of their technical interest, citations received from other patents, family size, current legal status, scope of the claims, and impact in the field.

FOCUS ON MAIN IP PLAYERS – Q2 2021

COSMX BATTERY - Overview

SAMPLE



Summary of patent activity for the main IP players in the COSMX battery space during Q2 2021. This section provides a detailed overview of the filings and grants for the top 50 players, highlighting key trends and competitive dynamics in the market.

FOCUS ON MAIN IP PLAYERS – Q2 2021

COSMX BATTERY - Notable patents selected by Knowmade analyst

SAMPLE

Patent No.	Applicant	Inventor	Abstract
USXXXXXX	Apple Inc.	John Doe	Systems and methods for battery management in mobile devices...
USXXXXXX	Samsung Electronics Co., Ltd.	Jane Smith	Methods and apparatuses for controlling a battery...
USXXXXXX	Tesla, Inc.	Michael Johnson	Systems and methods for battery charging and monitoring...
USXXXXXX	LG Chem, Ltd.	Emily White	Methods and apparatuses for battery cell manufacturing...

[USXXXXXX](#) Clickable link to pdf document

Notable patents were selected on the basis of their technical interest, citations received from other patents, family size, current legal status, scope of the claims, and impact in the field.



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