

NMC Lithium-ion Batteries

Patent Landscape Analysis

July 2017



REPORT
SAMPLE

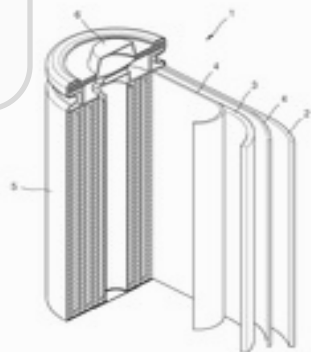
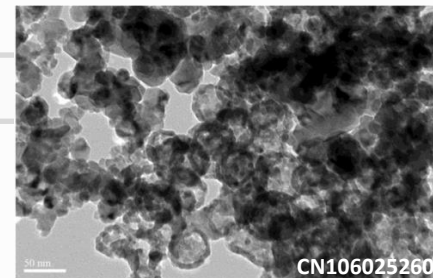
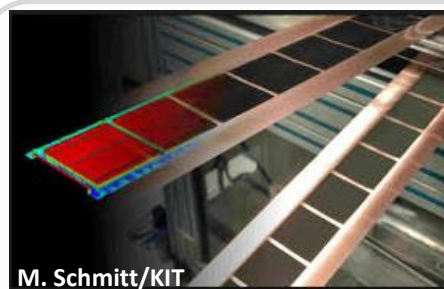


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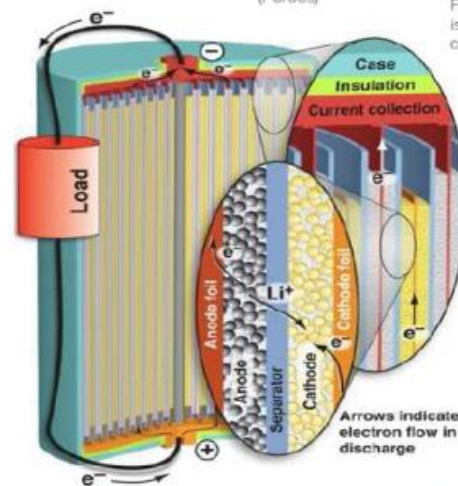
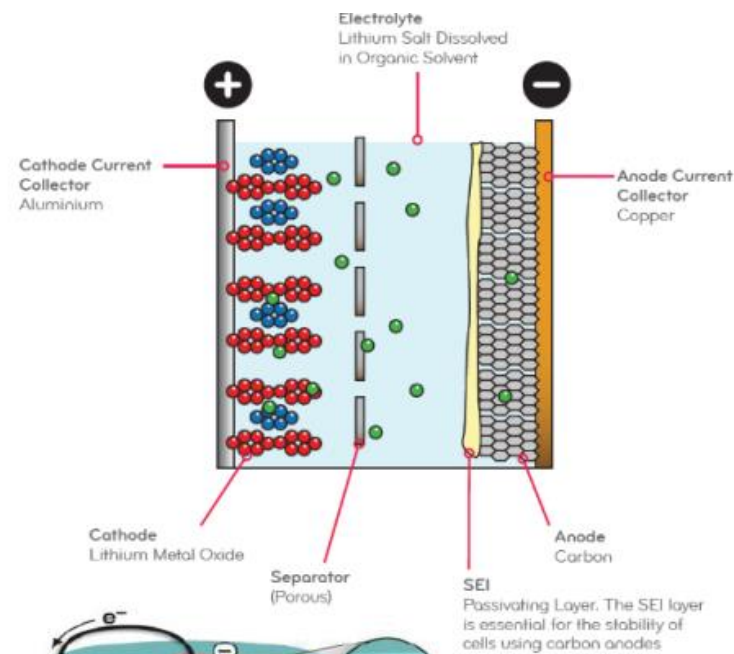
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INTRODUCTION TO LI-ION BATTERY

Li-ion Battery Cell Components and Materials used (1/2)

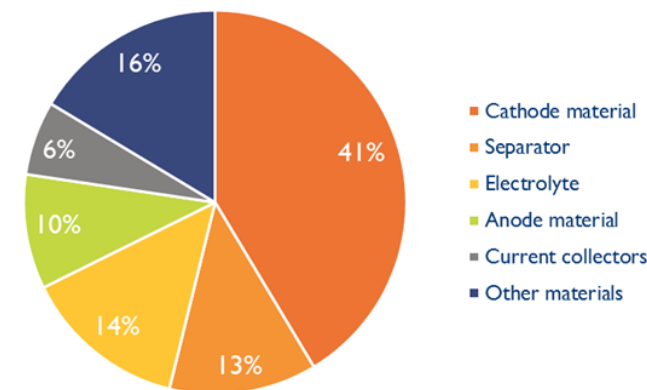
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- A “battery” is an electrochemical source of electricity, which stores energy in a chemically bound form until converting it directly into electric power
- Battery cells typically consist of a container, electrodes (anode, cathode), separator material, electrolyte, and conductive current collectors
 - The container is the metal can, plastic case, or foil pouch housing of the cell
 - The anode (negative electrode) is where the cell's oxidation reaction takes place, generating electrons to the external circuit
 - The cathode (positive electrode) is where the cell's reduction reaction takes place, consuming electrons from the external circuit
 - The separator is a physical barrier which electrically insulates the anode from the cathode. It prevents electrical internal short-circuits but allows anions and cations to freely pass through it.
 - The electrolyte is the medium providing the ionic conduction inside the battery
 - The conductive current collectors are typically the carrier metal substrates holding the anode/cathode active ingredients. In lithium-ion batteries these are copper foil for the anode and aluminum foil for the cathode.
- Lithium-ion batteries include a variety of chemistries with different properties and performance characteristics



Cylindrical spirally wound Li-ion cell

Li-Ion Cell Bill-of-Materials



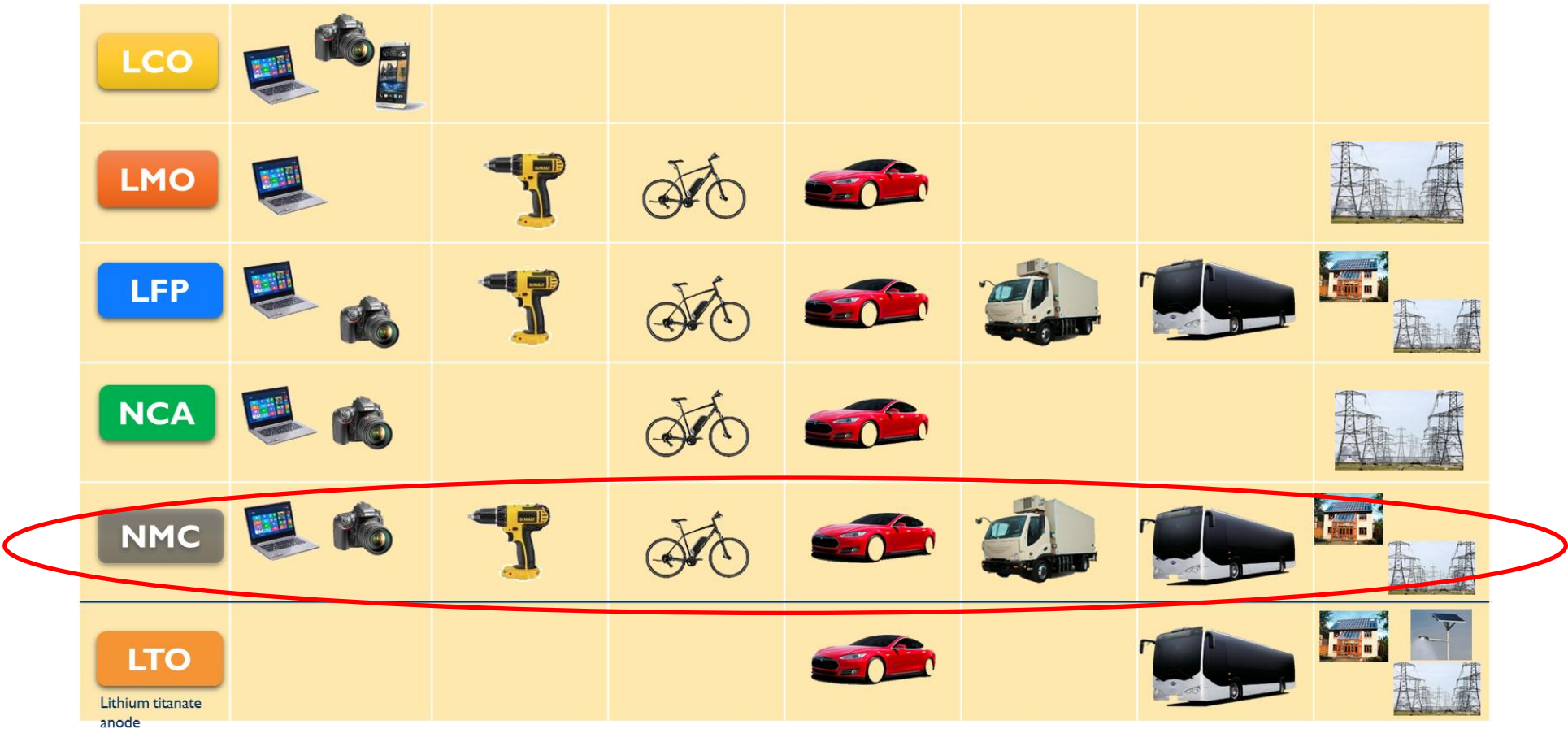
Source: Yole Développement, Beyond Li-ion battery (Report 2016)

INTRODUCTION TO LI-ION BATTERY

Li-ion Battery Type by Applications

REPORT
SAMPLE

NMC materials can be used in a wide range of applications.



Main application focus areas regarding the cell type
Yole Développement

Source: Yole Développement, Status of Rechargeable Li-ion Battery Industry (Report 2017)

SCOPE AND OBJECTIVES OF THE REPORT

Scope of the Report



- This report provides a detailed picture of the patent landscape for **Lithium Nickel-Manganese-Cobalt Oxide (NMC) batteries**.
- This report covers **patents published worldwide up to March 2017**.
- We have selected and analyzed more than **8,860 patents and patent applications** (3,335+ patent families) relevant to the scope of this report.

Included in the report

- Patents related to **Lithium batteries** AND related to **material manufacturing, electrode manufacturing** or **batteries comprising NMC as cathode material** AND **focused on NMC or referring to NMC among a list of materials in the claims** (except Li-S and Li-Air batteries).
- Patents related to **NMC** materials refer to:
 - **Patents related to Lithium Nickel-Manganese-Cobalt Oxide** (i.e. NMC, $\text{Li}_w\text{Ni}_x\text{Mn}_y\text{Co}_z\text{O}_2$) and **modified NMC materials** (i.e. $\text{Li}_w\text{Ni}_x\text{Mn}_y\text{Co}_z\text{O}_{(2-a)}\text{-X}_a$, $\text{Li}_w\text{Ni}_x\text{Mn}_y\text{Co}_z\text{Me}_a\text{O}_2$)
 - Patents **claiming the use or manufacturing method of $\text{Li}_w\text{Ni}_x\text{Mn}_y\text{Me}_z\text{O}_2$ materials** (Me can be one or several metals selected among Ni, Co, Mn ...)
 - Patents **claiming the use or manufacturing method of LiMeO_2** (Me can be one or several metals selected among Ni, Co, Mn ...) and **describing the use or manufacturing method for NMC in the examples**

Not included in the report

- Patents related to other materials comprising Nickel-Manganese-Cobalt (e.g. $\text{Li}_w\text{Ni}_x\text{Mn}_y\text{Co}_z\text{Me}_a\text{O}_4$, $\text{Li}_w\text{Ni}_x\text{Mn}_y\text{Co}_z\text{Me}_a\text{PO}_4$, $\text{Li}_w\text{Ni}_x\text{Mn}_y\text{Co}_z\text{Me}_a\text{SO}_4$...)
- Patents which do not mention the use or the manufacturing method of NMC in the claims
- Patents related to **NMC for other applications than Lithium Batteries**
- Patents related to systems integrating a NMC battery
- Patents related to a method to control the charge rate of NMC battery.

SCOPE AND OBJECTIVES OF THE REPORT

Objectives of the Report



OBJECTIVES OF THE PRESENT PATENT LANDSCAPE

- ✓ Understand the IP landscape of NMC Lithium-ion batteries.
- ✓ Identify the major IP players in NMC for Lithium-ion batteries and the relative strength of their patent portfolio related to precursor, material, electrode and battery manufacturing.
- ✓ Identify the newcomers in NMC Lithium-ion batteries (precursor, material, electrode, battery manufacturing).
- ✓ Identify the IP collaboration networks between key players.
- ✓ Identify the key NMC related patents related to precursor, material, electrode and battery manufacturing.
- ✓ Understand the IP trends related to NMC Lithium-ion batteries and future technological choices.
- ✓ Identify and understand the main patent litigations.
- ✓ Compare the position of the companies both in the market and the IP landscape.

MAIN PATENT ASSIGNEES MENTIONED IN THIS REPORT

INDUSTRIALS

3M, A123 Systems, AGC Seimi Chemical, Amogreentech, Amperex Technology, Asahi Glass, Automotive Energy Supply, Bak International, BASF, BMW, Boston Power, Brunp Recycling Technology, BYD, Chery Automobile, China FAW Automobile, Citic Dameng Holding, Daikin Industries, Denki Kogyo/Denka, Denso, Donguan Kaixin Battery Material, Du Pont De Nemours, Easpring Material Technology, Ecopro, Enerceramic, Envia, Fujifilm, General Motors, GS Yuasa, Hitachi Chemical, Hitachi Maxell, Hitachi Metals, Hitachi Vehicle Energy, Honda Motor, Huawei Technologies, Jinhe New Materials, Johnson Controls Technology, JX Nippon Mining Metals, Kokam, L&F, Leneng Battery, Leyden Energy, LG Chem, Li-Tec Battery, Medtronic, Mitsubishi Chemical, Mitsubishi Materials, Mitsui Mining & Smelting, Murata Manufacturing, Nano One Materials, Nec, Ningxia Orient Tantalum Industry, Nippon Chemical Industrial, Nippon Shokubai, Nissan Motor, Panasonic, Posco, PPG Industries, Renault, Reshine New Material, Robert Bosch, SAFT, Samsung Electronics, Samsung SDI, Sanyo Electric, Seo, SEL, SK Innovation, Solvay, Sony, Sumitomo Chemical, Sumitomo Metal Mining, Tanaka Chemical, Techelios, Toda Kogyo, Toray Industries, Toshiba, Toyota Industries, Toyota Motor, Umicore, Wanxiang ...

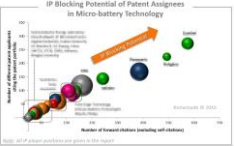
R&D LABORATORIES

CEA, Central South University, CNRS, Fujian Normal University, Harbin Institute of Technology, KETI, KERI, Osaka City University, RIST, UNIST, University of Chicago, University of Jiangnan, UT Battelle ...

RELATED REPORTS

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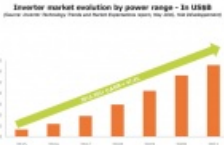
You may also be interested in our previous reports:



- Microbattery Patent Landscape (September 2016) ([link](#))



You may also be interested in those market analysis reports of our partner Yole Développement:



- Status of Rechargeable Li-ion Battery Industry (July 2017) ([link](#))
- Stationary Storage and Automotive Li-ion Battery Packs (May 2016) ([link](#))



METHODOLOGY

Patent Search, Patent Selection, Patent Analysis (1/2)



- The data were extracted from the **FamPat worldwide database** (Questel-ORBIT) which provides 90+ million patent documents from 95 offices.
- The search for patents was performed in **March 2017** hence patents published after this date will not be available in this report.
- The patents were grouped by **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.
- The selection of the patents has been done both automatically and manually (all details in next slides).

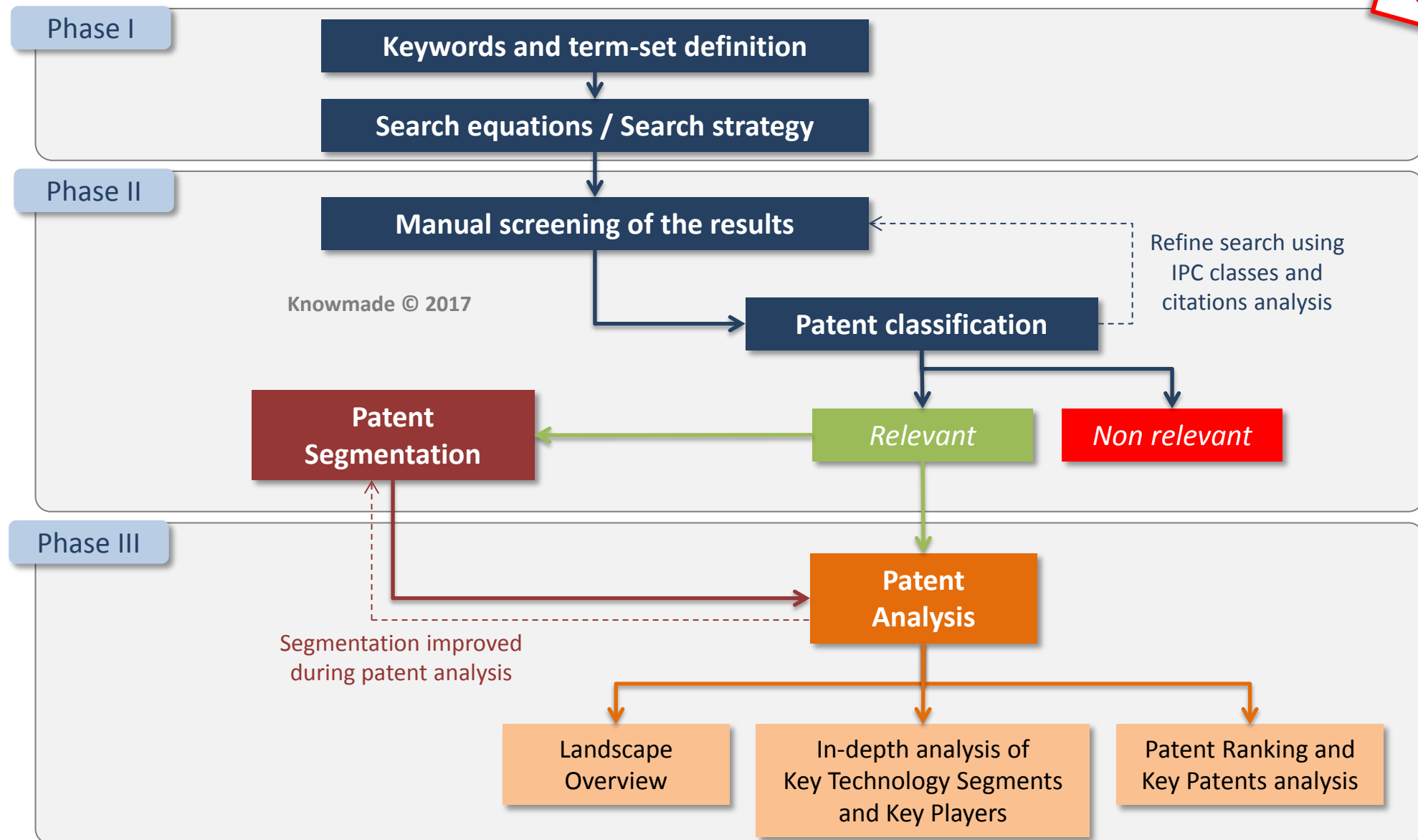
More than 3,335 patent families related to NMC Lithium-ion batteries have been selected for the study

- The statistical analysis was performed with **Orbit IP Business Intelligence** web based patent analysis software from Questel.
- The patents were **manually categorized in technical segments** using keyword analysis of patent title, abstract and claims, in conjunction with expert review of the subject-matter of inventions (all details in next slides).
- For legal status of European (EP) and PCT (WO) patent applications, EPO Register Plus has been used. For legal status of US patents, USPTO PAIR has been used. For legal status of other patents, information have been gotten from their respective national registers.

METHODOLOGY

Patent Search, Patent Selection, Patent Analysis (2/2)

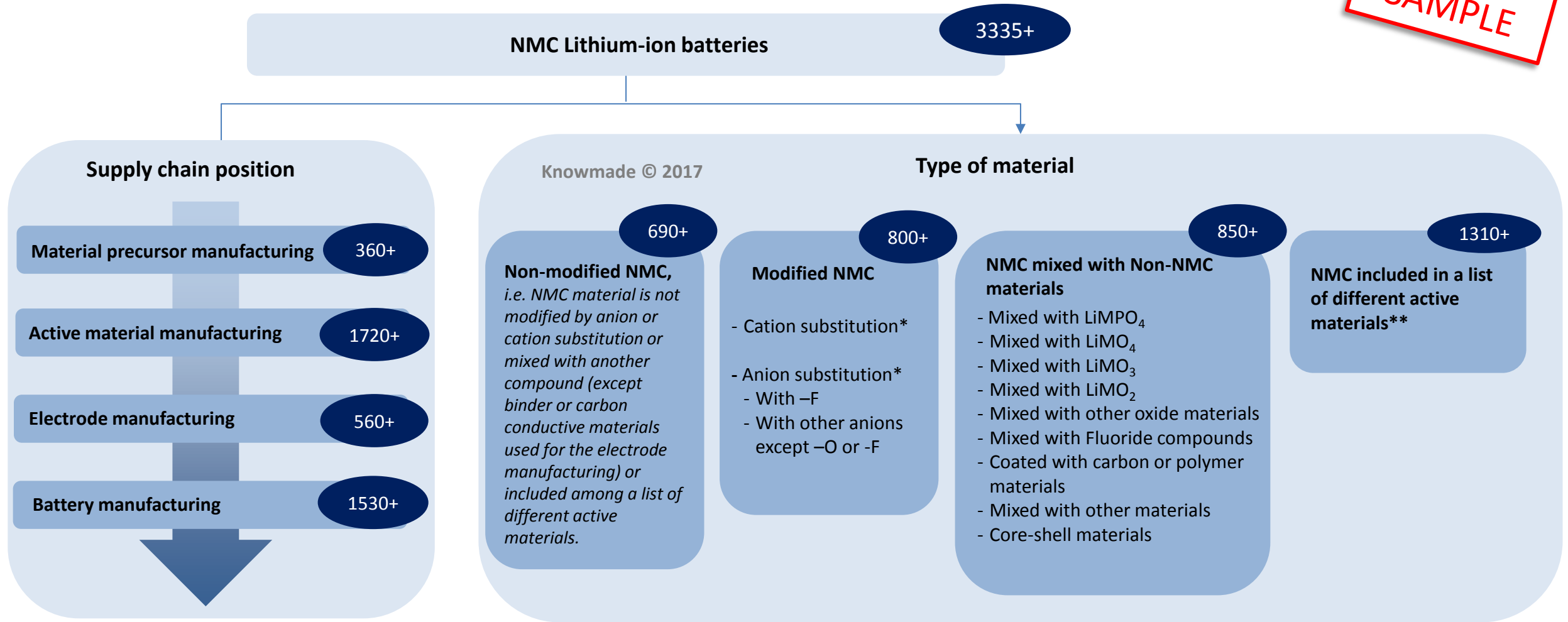
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METHODOLOGY

Patent Segmentation

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The numbers represent the number of patent families in the corresponding segment. A patent family can belong to several technical segments.

* “Substitution” shall be understood as partial replacement of the considered element, i.e. Co, Ni or Mn for cation substitution and O for anion substitution.

** By “NMC included in a list of different active materials”, we intended patents not focused on NMC material but which claim for example : “cathode material which includes NMC, LiMPO_4 , LiCoO_2 , or LiMn_2O_4 ...” or LiMeO_2 or LiNiCoMeO_2

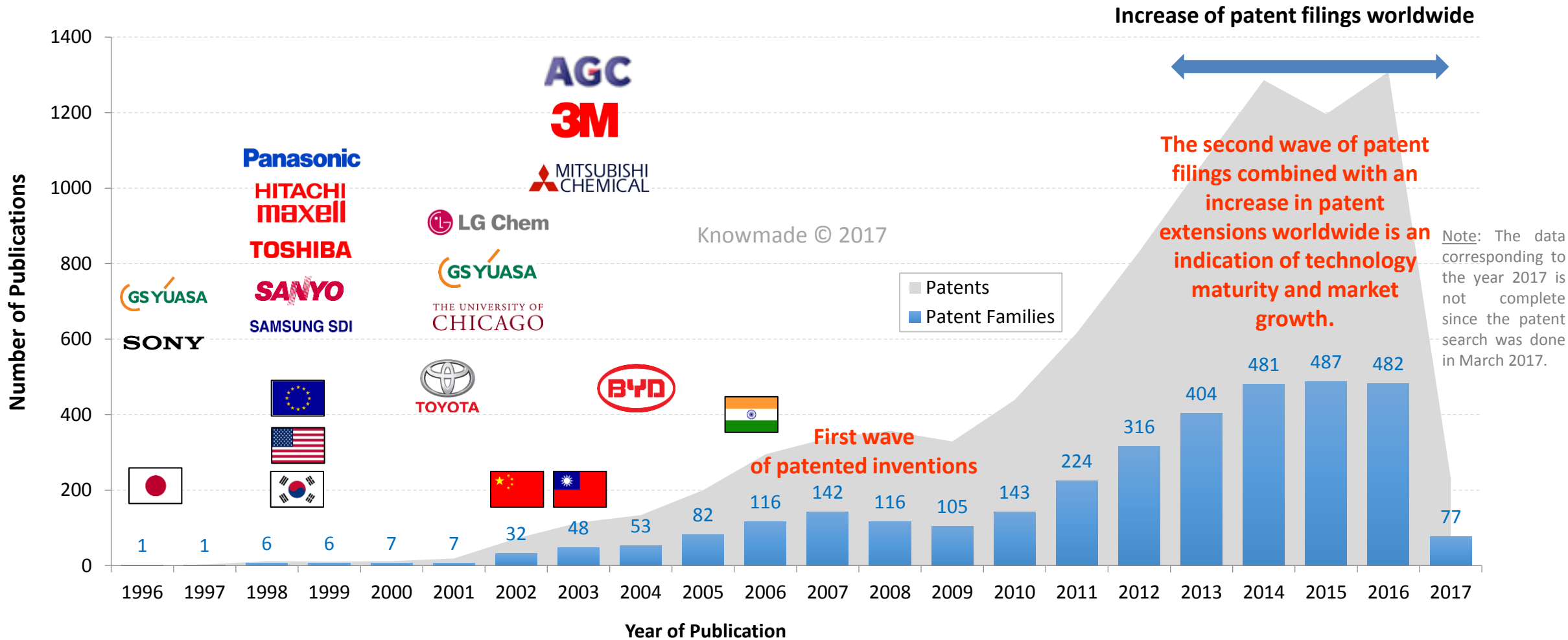
PATENT LANDSCAPE OVERVIEW

Time Evolution of Patent Publications

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NMC Lithium-ion battery IP Dynamics

3,330+ patent families comprising 8,980+ patents
published over the last past 20 years



PATENT LANDSCAPE OVERVIEW

Main Patent Assignees

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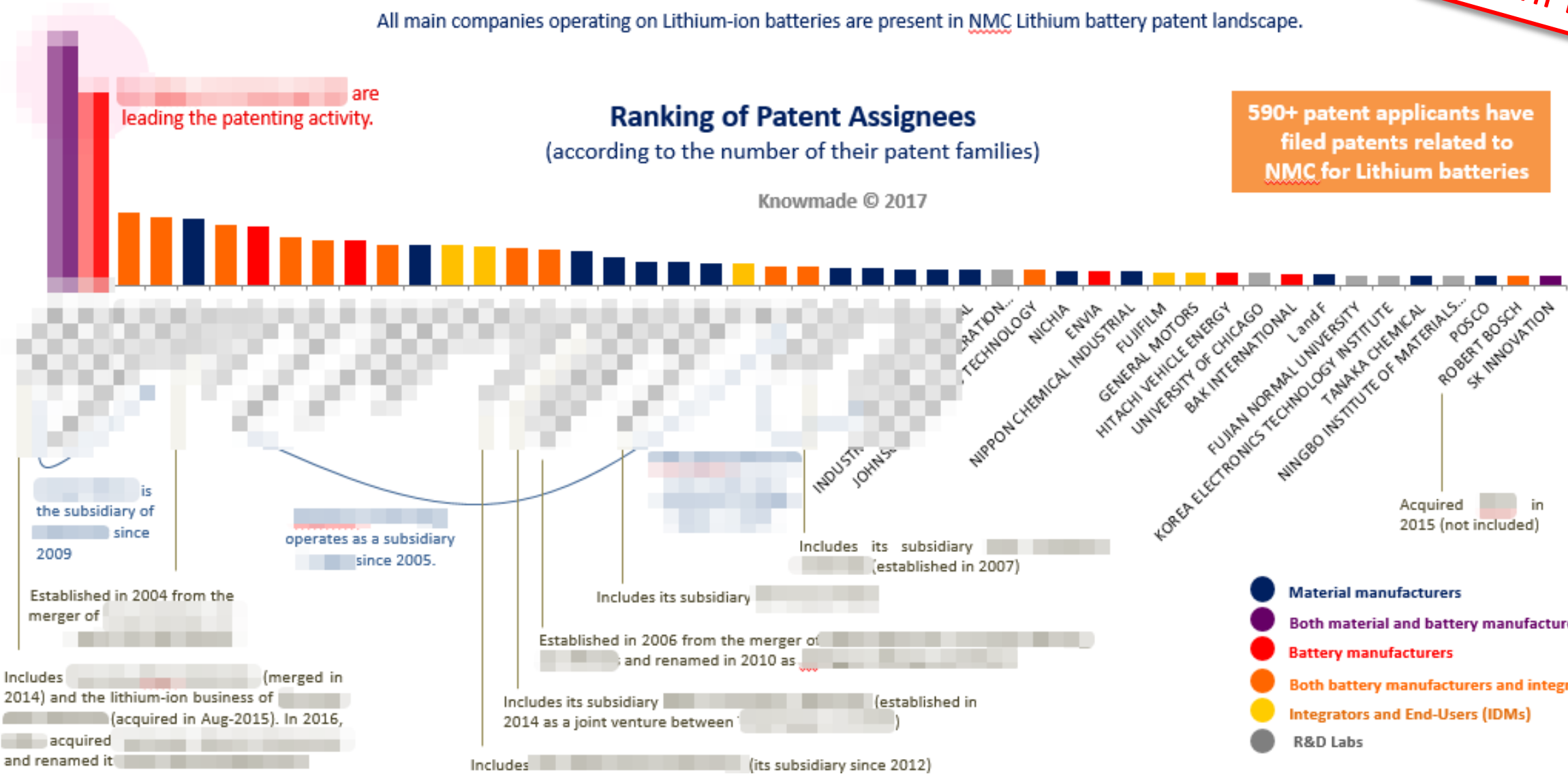
All main companies operating on Lithium-ion batteries are present in NMC Lithium battery patent landscape.

Ranking of Patent Assignees (according to the number of their patent families)

Knowmade © 2017

590+ patent applicants have
filed patents related to
NMC for Lithium batteries

are
leading the patenting activity.

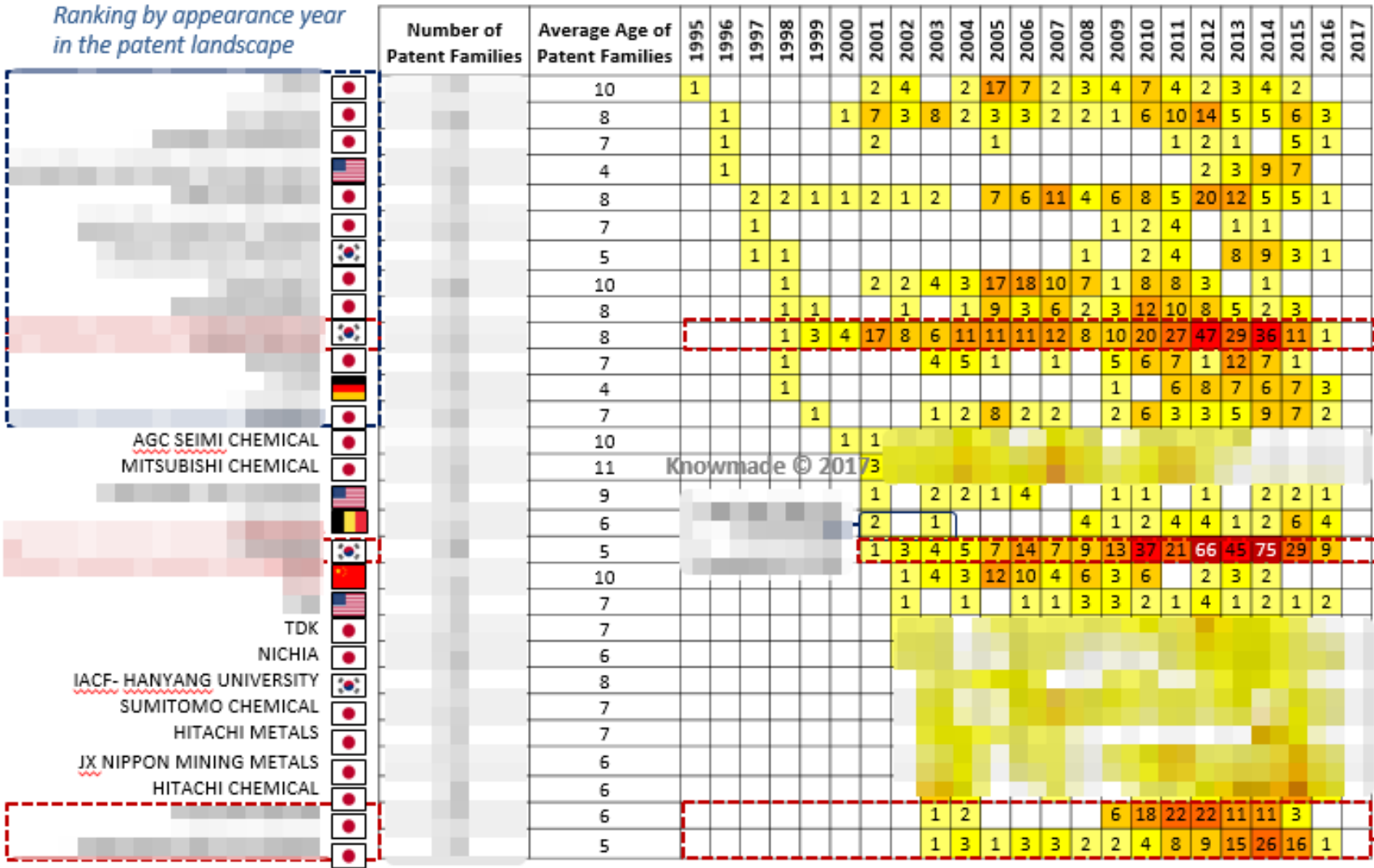


PATENT LANDSCAPE OVERVIEW

Time Evolution of Main Patent Assignees (1/2)

For each year, the numbers represent the numbers of patent families.

Earliest year of application for each patent family



Note: Due to the delay between the publications by patent offices, usual corresponding to the year 2015, 2016 and since most patents filed during these years

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Old IP players still active

- commercialized the first Lithium battery in 1991. The cathode material was LiCoO2.
- were the market leaders for Lithium batteries in 1990's.

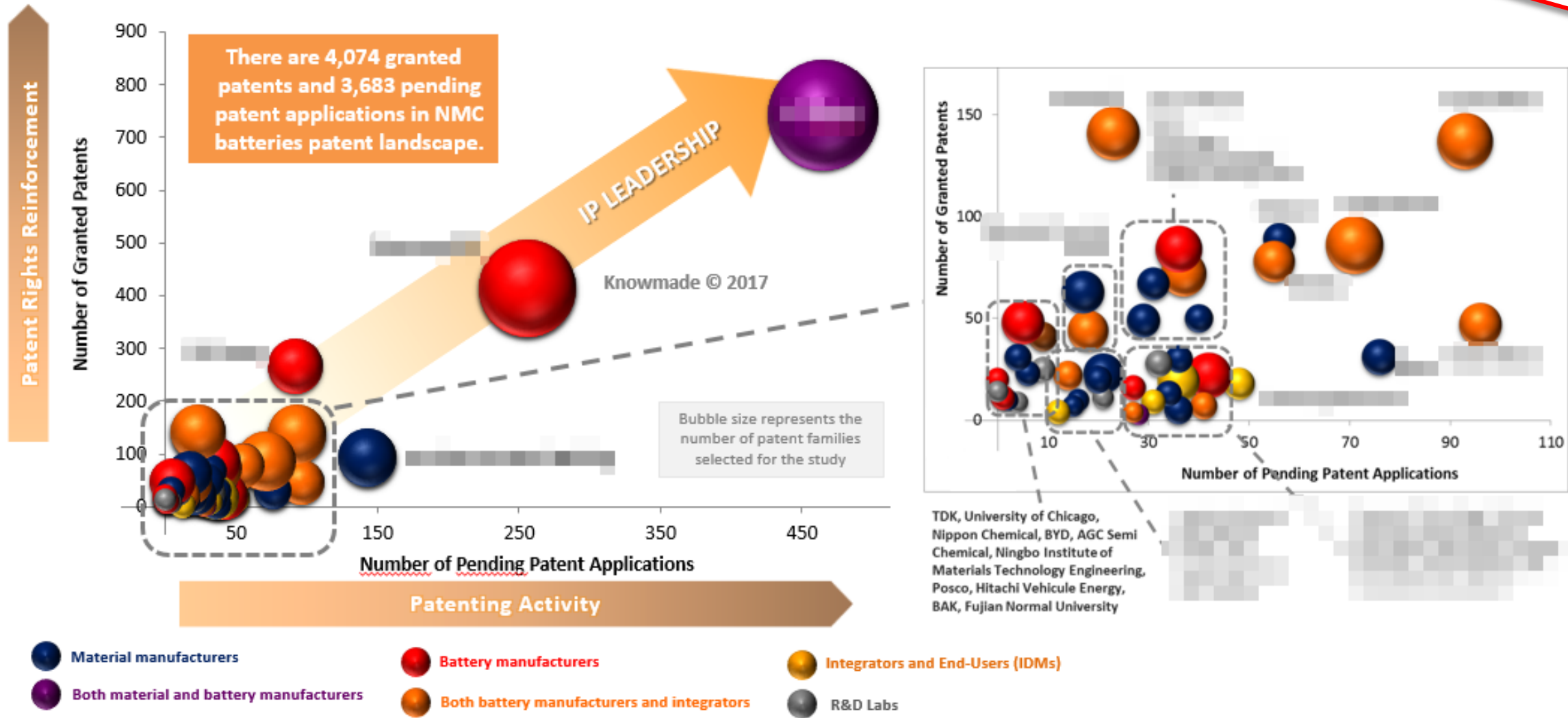
The most active players since 2009

- Korean manufacturers entered in battery market in 1998 and 1999 respectively.
- 's Hybrid Electrical Vehicles adopted Lithium Batteries in 2012.
- In November 2016, announced that it will withdraw from the making of lead frames for semiconductor package and use the proceeds to boost production of cathode materials for lithium batteries

PATENT LANDSCAPE OVERVIEW

IP Leadership of Main Patent Assignees (1/2)

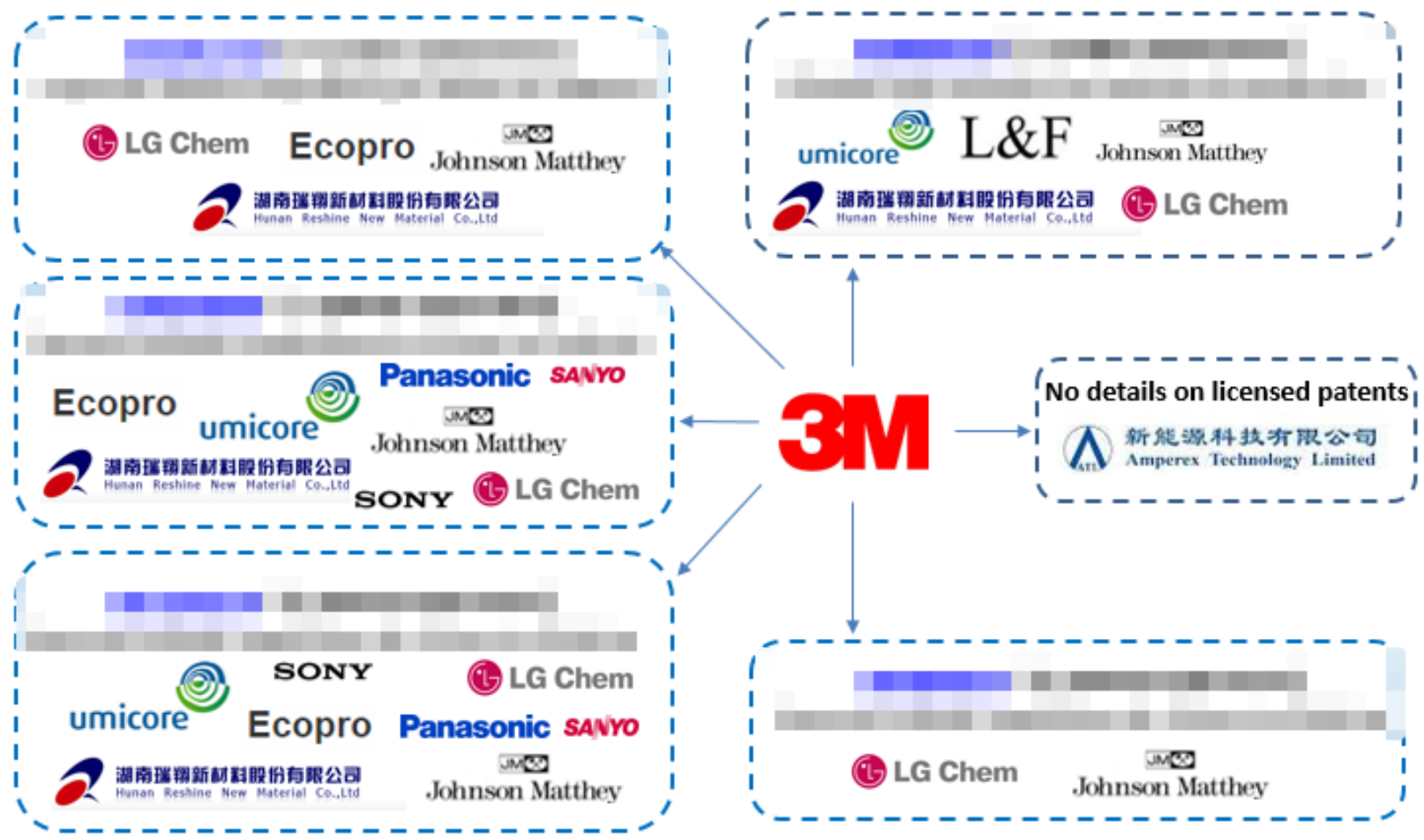
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PATENT LANDSCAPE OVERVIEW

Licenses of patents from 3M

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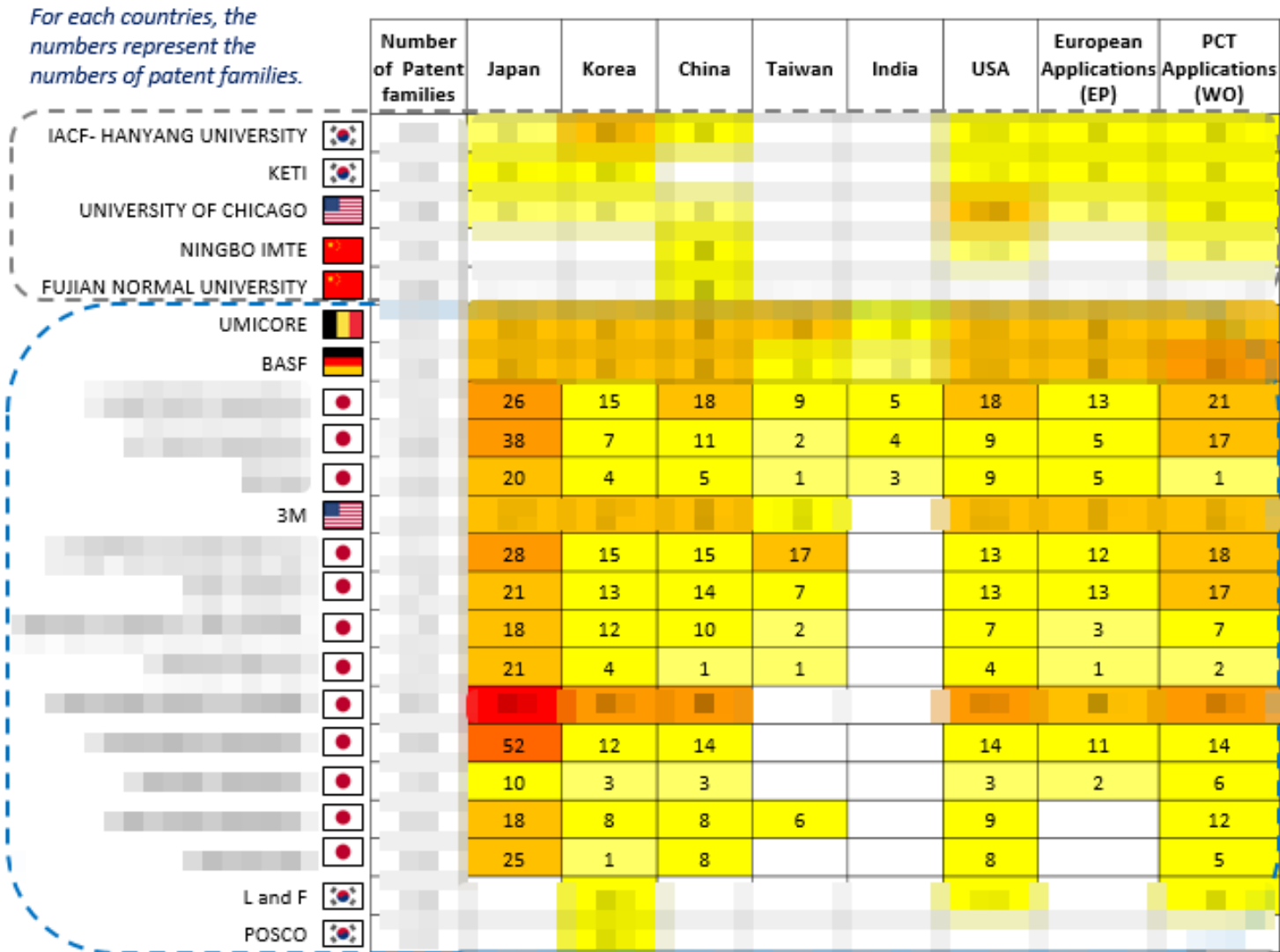
* Patents acquired by in Dec-2016

- [redacted] signs its license agreement with 3M in 2009.
- [redacted] signs its license agreement with 3M in 2012.
- [redacted] sign their license agreements with 3M in 2013.
- [redacted] signs its license agreement with 3M in 2015.
- [redacted] signs its license agreement with 3M in 2016.
- [redacted] sign their license agreements in 2007 to end a patent litigation and International Trade Commission (ITC) investigation filed by 3M against them.
- [redacted] signs its license agreement with 3M in 2010 and 2011. In December 2016, [redacted] acquires NMC battery material patents from 3M (marked with * in the scheme). The deal includes all existing and future licensing rights.
- [redacted] belong to the same patent family. Some of them were involved in patent litigations in 2007.

PATENT LANDSCAPE OVERVIEW

Countries of Patent Filing for Main R&D Labs and Material Manufacturers

REPORT
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R&D labs

Industry Academic Cooperation Foundation-Hanyang University, Korea Electronics Technology Institute (KETI) and University of Chicago have [redacted] contrary to Fujian Normal University and Ningbo Institute of Materials technology Engineering, which mainly filed their patents [redacted]

Patents in India and in Taiwan are mainly filed by material manufacturers. Most of material manufacturers filing patents in India and Taiwan have operating units there [redacted]

Material Manufacturers

They mainly have a worldwide IP strategy, except [redacted] which are mainly focused in their originating countries.

Countries are defined by the country code from the patent numbers. The number represents number of published patent families. Note that PCT (WO) and European (EP) applications may hide other countries that are not yet published.

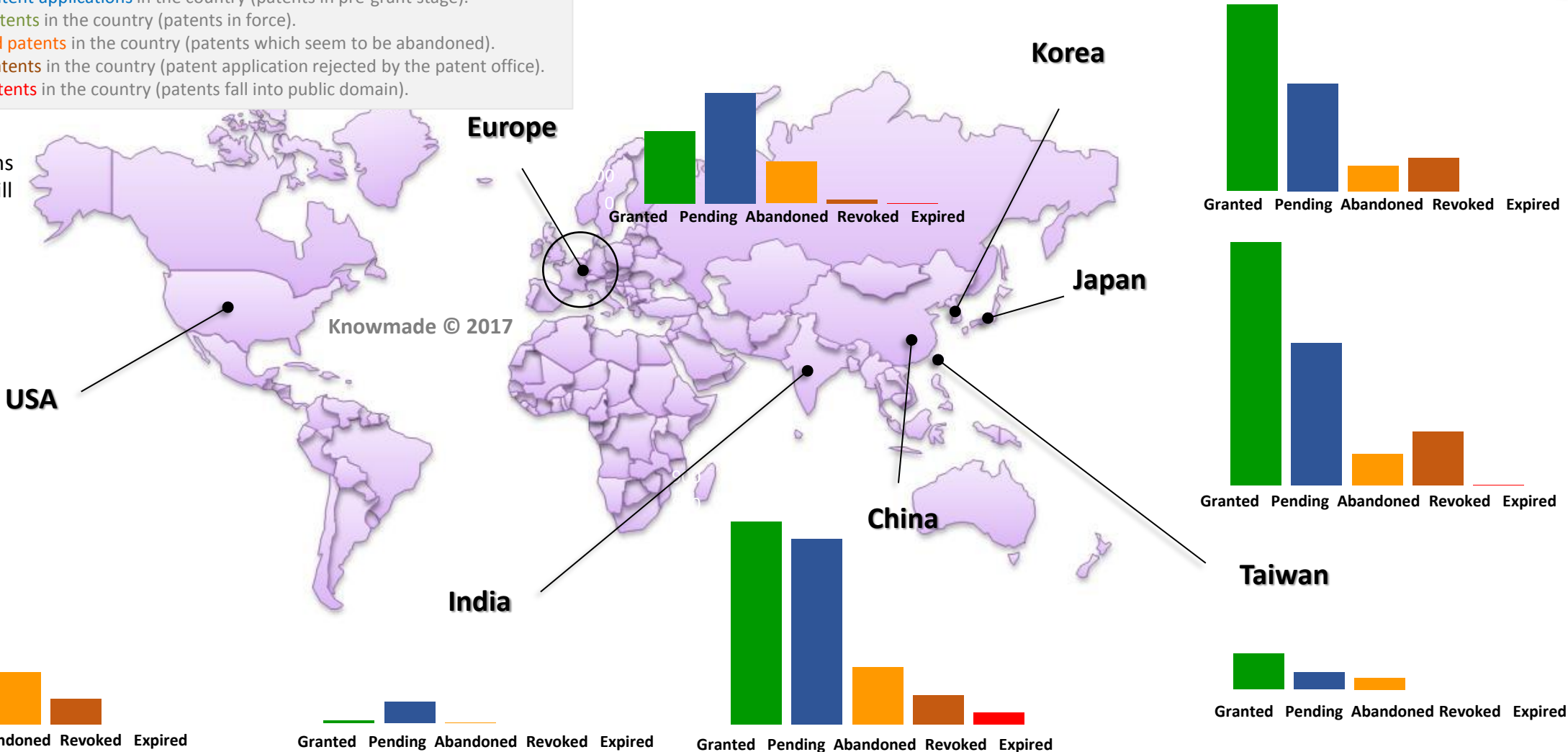
PATENT LANDSCAPE OVERVIEW

Mapping of Patenting Activity

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- For each country or geographical zone:
- Number of **patents** filed in the country.
 - Number of **pending patent applications** in the country (patents in pre-grant stage).
 - Number of **granted patents** in the country (patents in force).
 - Number of **abandoned patents** in the country (patents which seem to be abandoned).
 - Number of **revoked patents** in the country (patent application rejected by the patent office).
 - Number of **expired patents** in the country (patents fall into public domain).

xxx+ PCT applications
(WO patents) are still
in progress.



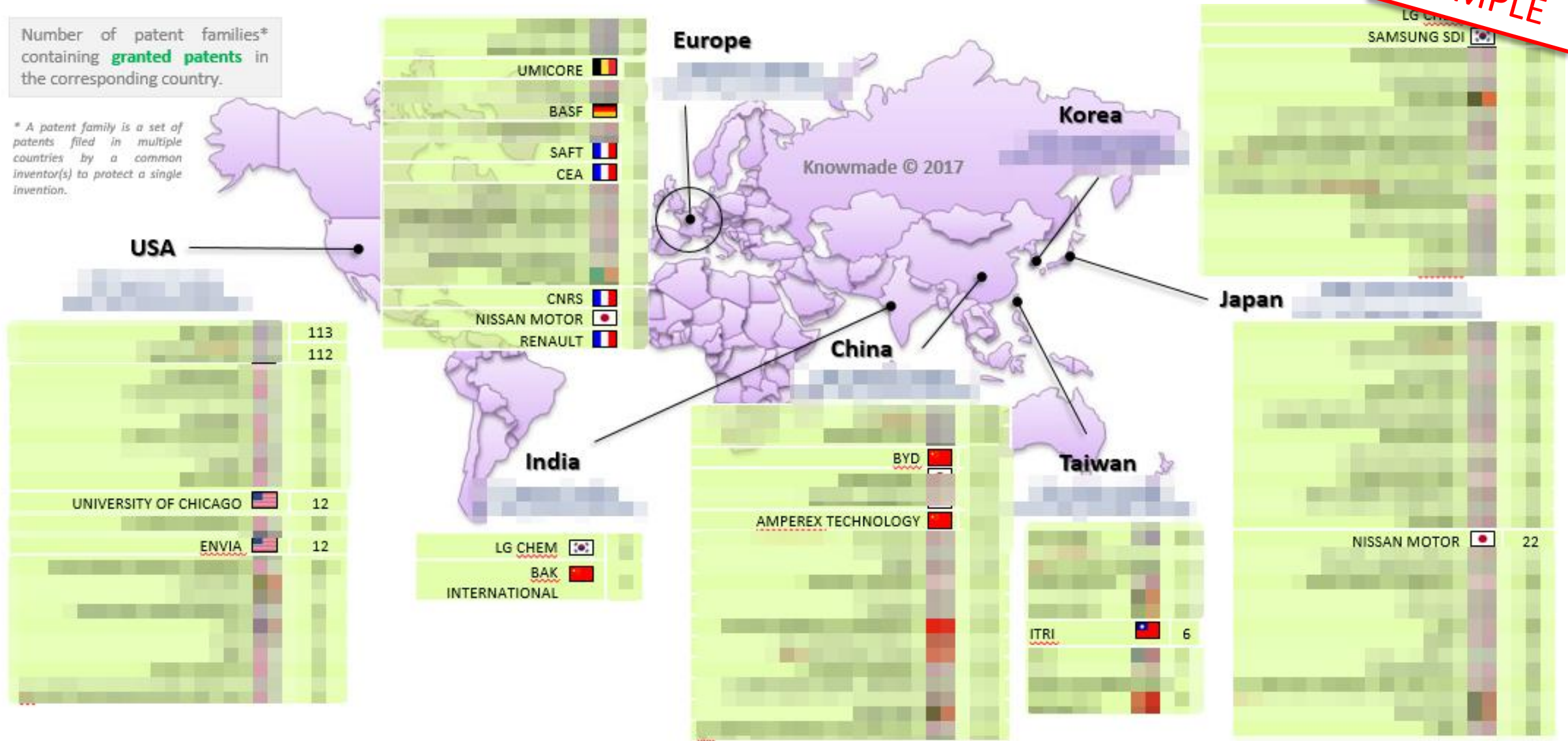
PATENT LANDSCAPE OVERVIEW

Mapping of Main Current Patent Holders

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Number of patent families* containing **granted patents** in the corresponding country.

* A patent family is a set of patents filed in multiple countries by a common inventor(s) to protect a single invention.



PATENT LANDSCAPE OVERVIEW

Patenting Activity of Main Patent Assignees

REPORT
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Patent Applicants	Number of patent families	Number of patent families containing granted patents in the corresponding country							Number of patent families containing pending patent applications in the corresponding country							PCT (WO)
		USA	Europe	Japan	Korea	China	Taiwan	India	USA	Europe	Japan	Korea	China	Taiwan	India	
		113	64	95	217	100	45	8	83		53	62	83	9	25	48
		112	34	50	152	45			85		29	79	35		1	2
		20	4	34	4	17			25		39	1	13	1		6
		21	2	61	22	26			25	7	25	7	13			5
		10	4	48	12	12			23	1	42	16	25			20
		36	1	42	22	31			13		19	1	2			
		16	12	51	3	20	2		14	2	19	15	10			3
		12		41	10	12			6		13	9	7	4		3
		16	1	19	5	18			6		12	4	7		1	3
				1		21			8		2		32			
		6	3	22	10	4			14		28	14	19		1	9
		7	3	31	6	8			4		10	2	1			
		6	2	2	2	33							5			
		21	1	23	8	15			9		20		10		1	4
		5	2	11	6	7	2		3		20	1	6		4	9
		3	9	8		8	1		17		12	18	12	3	1	7
		7	1	20	7	9			7		4	5	5		5	5
		8		16	11	12	15		5		10	1	3	2		2
		9	13	14	13	12	15		11		6	7	6	5	6	9
		1		2		1			7		23		6			
		8	5	18	3	8	3		8		6	10	7	2		1
		8	2	4	2	8	5		8		4	8	1	4		2
		1	1	5	1	1	1		3		14	3				2
		6		11	1	8			2		5					
		5	1			1			14				7			9
		2		6	1	2	1		7		12	3	2		3	
		12					1		11		2		1	9		
		5	1	9	5	2			1			2		2		
		12	1	1	1	1			6							
		5			1	1			10	7			10			3
					10				5			3				3
					2	1			10		1	8	8			

• Japanese and Korean material and battery manufacturers hold most of granted patents worldwide.

• [redacted] have the highest number of granted patents and pending patent applications worldwide. Contrary to [redacted] files numerous patent applications in India and Taiwan.

• [redacted] are the only European IP players with a noticeable IP position. Both have a worldwide IP strategy.

• Chinese battery manufacturers [redacted] mainly file patents in China. [redacted] holds much more granted patents than pending patent applications, suggesting a decrease of its R&D activities related to NMC. [redacted] holds numerous pending patent applications, suggesting recent developments in this field.

• New IP players in NMC Lithium-ion Battery field have been identified among the main current patent applicants [redacted] in Europe, [redacted] in USA, China and Korea, [redacted] in India, [redacted] in China, [redacted] in China, Korea and Japan...).

US PATENT LITIGATIONS

University of Chicago / BASF litigation campaign (1/5)

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- On February 2015, BASF and University of Chicago (Argonne) filed a patent infringement suit and an ITC Investigation against Umicore and Makita Corporation. The accused products are NMC materials and Li-ion batteries using them. Umicore was accused to [redacted]. Makita was accused to [redacted].
- Two patents belonging to the same patent family are involved in the lawsuit [redacted]. They are related to related to [redacted].
- University of Chicago (Argonne) is the assignee of those patents and has partnered with BASF to commercialize NMC technology, granting BASF an exclusive license under these patents. During the procedure, Sonv/Makita and Umicore tried to invalidate the two patents [redacted].

Conclusions of the patent lawsuits by defendants

Plaintiff	Defendants	Status	Termination date (dd-mm-yyyy)	Conclusion
University of Chicago (Argonne) BASF	Makita	Closed	25-11-2015	[redacted]
	Umicore	Closed	05-05-2017	[redacted]

Filing details of the patent lawsuits in the campaign

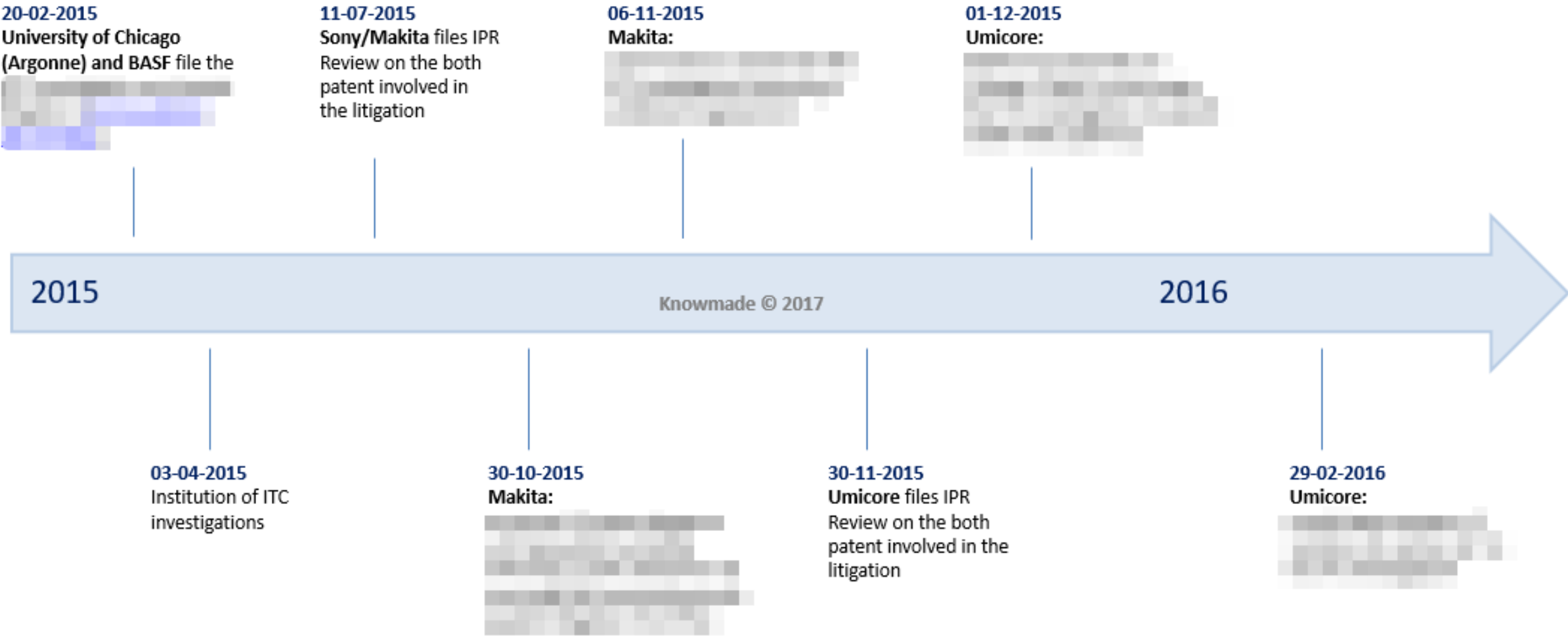
Case Number	Date of filing (dd-mm-yyyy)	Court	Judge	Nature of suit	Cause (International Conventions)	Patents in the lawsuits
[redacted]	20-02-2015	District of Delaware	Leonard P. Stark	Wilful Patent infringement	[redacted]	[redacted]
[redacted]		ITC	Thomas B. Pender	Patent infringement	[redacted]	

US PATENT LITIGATIONS

University of Chicago / BASF litigation campaign (3/5)

REPORT
SAMPLE

Chronology of main events during the patent lawsuits



US PATENT LITIGATIONS

University of Chicago / BASF litigation campaign (5/5)

Patents involved in the lawsuit and their legal status

Patent number	Application date (yyyy-mm-dd)	Grant date (yyyy-mm-dd)	Expected expiration date* (yyyy-mm-dd)	Current Legal status
	2001-11-21	2004-01-20	2021-11-21	Granted
	2001-06-21	2004-01-13	2021-06-21	Granted

The two patents belong to the same patent family.

Title:

Assignee: University of Chicago (Argonne)

Technology description

- electrode for a n
a general formul
ions having an a
here M' is one o
one ion being M
the ratio of Li to
- synthesizing a li
ed above, in whic
35 atmospheres a
- a negative electr
sitive electrode f
M'O₃ as describe
- ty of cells as desc

Geographic coverage and legal status of patents in the patent family



The date below the patent number corresponds the patent application date.

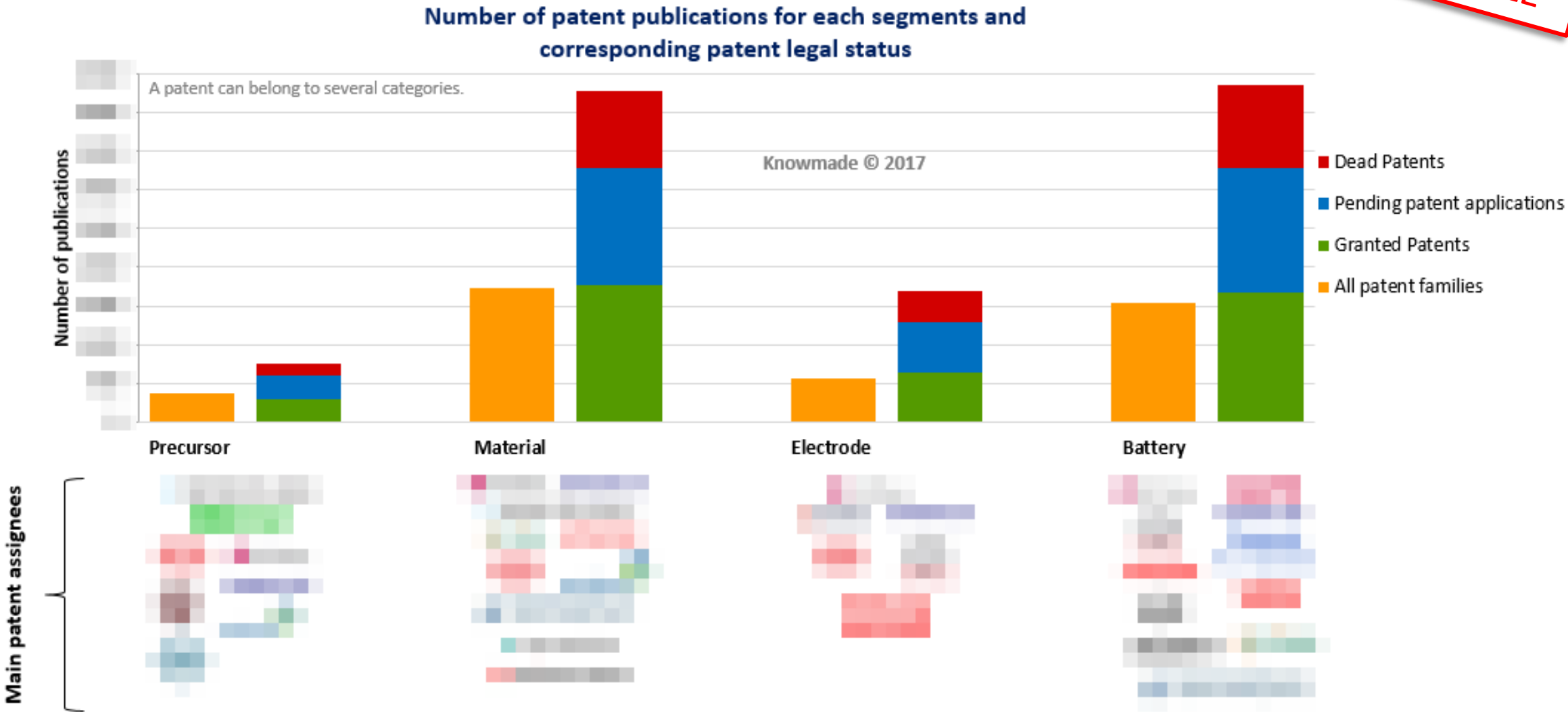
Patent legal status

Green box: Granted Blue box: Pending Red box: Dead

SUPPLY CHAIN POSITION - OVERVIEW

Patents Split by Supply Chain Segments and their Legal Status

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SUPPLY CHAIN POSITION - OVERVIEW

Main Material Manufacturers vs Supply Chain

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	Number of patent families	Precursor	Material	Electrode	Battery
		35	92	3	1
			29	3	
		1	24		
		1	19	1	
		2	19		
			15		
		4	14		
		2	13		
		2	11	1	
		5	9		
		6	8		
		5	5		
		1	29	4	2
			21	2	4
			25	35	9
		3	22	14	16
			21	6	11
			12	5	15
			9		3
		1	6	1	9
		2	5		2
		2	2		3
			6	8	46
			1		11
				2	11
					8
				1	3
				5	1

Note: The numbers represent the number of patent families.
A patent can belong to several categories.

Material manufacturers with only few patents related to NMC electrode manufacturing and NMC use in battery
Patents mainly claim NMC material manufacturing methods.

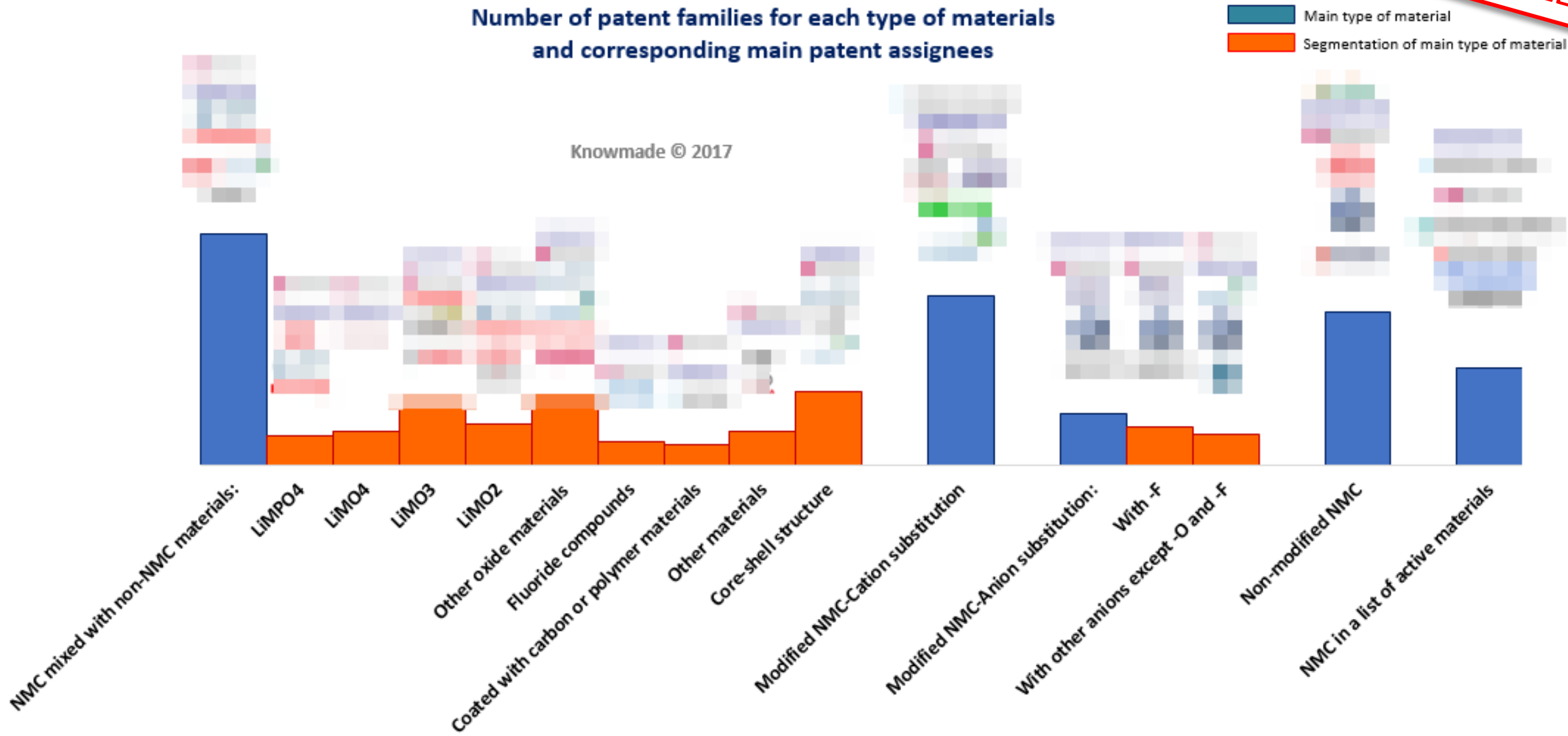
Material manufacturers with patents related to NMC electrode and batteries using NMC electrode
Electrode and battery manufacturing methods or compositions can be claimed in the same patent than material manufacturing methods.

Material manufacturers without patents related to NMC Material or Precursor Manufacturing
Some patents claim the manufacturing of another battery component materials (electrolyte, negative electrode, separator, binder ...) and its use in a battery comprising NMC as positive electrode material.

MATERIAL MANUFACTURING

Patents Split by Type of materials

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MATERIAL MANUFACTURING

Main Material Manufacturers vs Type of Materials

REPORT
SAMPLE

Number of patent families	NON-MODIFIED NMC	NMC in a list of different active materials	NMC MODIFIED BY				NMC MIXED									
			Cation substitution	Anion substitution	Anion substitution with F	Other anion substitution	with Non-NMC materials	with LiMPO ₄	with LiMO ₄	with LiMO ₃	with LiMO ₂	with other oxide materials	with Fluoride compounds	coated with carbon or polymer	with other materials	Core-shell structure
	7	25	54	1		1	10			3		3		5		2
	7	16	5				3					2			1	
	7	14	5	1	1		3				1	2				
	9	8	5				4		1			1			2	
	7	1	12	1		1	5	1		1	2	1	1			4
	4		15	3	3		5			1		2	2		3	
	4	5	7				8			3	3	3	1		1	6
	1	5	14	10	10		1				1					
	1	2	11				7		1	2	1				3	1
	7	1	7	3	2	1	6	1			2	2			2	1
		5	1	1		1	10				2	4	3		6	8
	8	2	4				1				1					
	1	2	5	3	3	3	5			1	1	1				3

Companies have several strategies in term of types of materials:

- LG Chem files patents on
- Umicore mainly files patents on
- BASF mainly files patents on
- Sumitomo Metal Mining mainly files patents
- JX Nippon Mining and Metals, Sumitomo Chemical and Mitsubishi Chemical mainly file patents on

MATERIAL MANUFACTURING

Market vs IP Position

* IP position of each companies has been determined from the IP leadership, Prior Art Strength Index and their patent portfolio in each supply chain

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Market position	
No commercialized NMC material	Commercialized NMC materials
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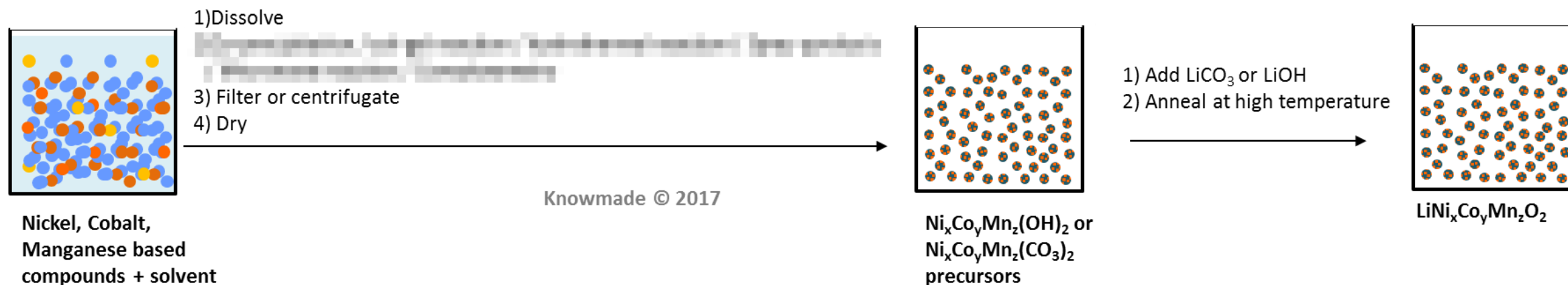
- Patents on NMC material manufacturing are filed by battery and material manufacturers. Battery manufacturers doesn't commercialize material but often have an R&D department dedicated to battery material manufacturing and evaluation.
- Chinese material manufacturers have a [redacted] seems to be the only Chinese material manufacturer to have a license on NMC material manufacturing (from 3M's NMC patent portfolio).
- [redacted] reach a stronger IP position thanks to their license agreements on key NMC patents of 3M. Patents involved in these licensing agreement have been acquired by [redacted] in December 2016. Licensing agreements were also part of the deal.
- [redacted] hold license agreements on NMC patents of University of Chicago. University of Chicago has a strong IP position in NMC material manufacturing patent landscape. [redacted] reaches a stronger IP position thanks to these license agreements.
- Material manufacturers mainly commercialize non-modified NMC, except [redacted] who also commercialize core-shell and gradient NMC, [redacted] who also commercialize double-phase NMC materials (xLiMO₂·(1-x)Li₂M'O₃).
- [redacted] commercializes NMC materials developed at University of Chicago.

MATERIAL MANUFACTURING

Overview of main synthesis methods of NMC

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General synthesis methods



NMC modifications

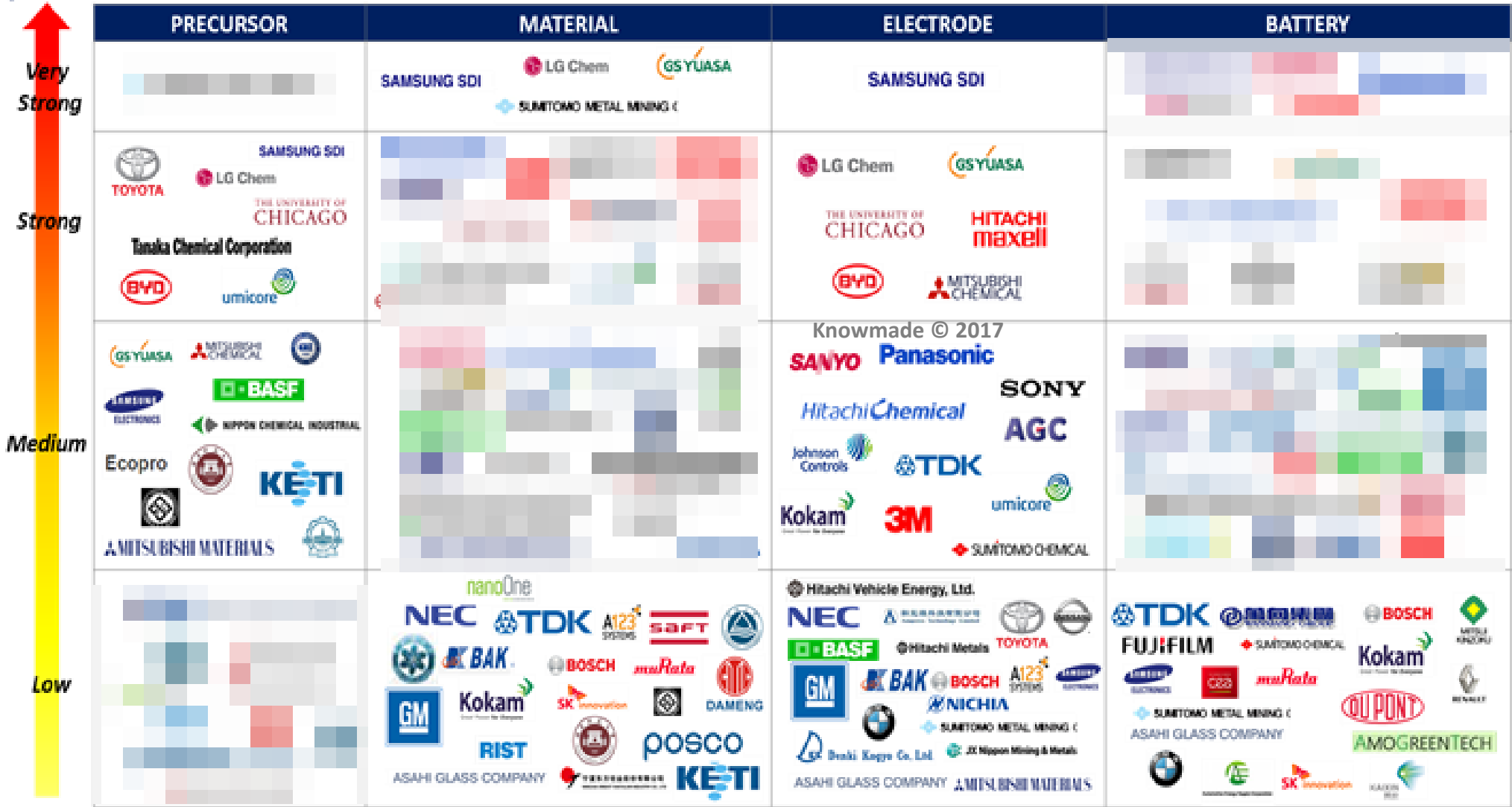
- **NMC cation substitution** is done during the first or the second reaction step. A salt of the substitution cation is added to the reaction mixture or NMC precursor.
- **NMC anion substitution** is mainly done during the second reaction step. A salt of the substitution anion is added to NMC precursor at the same time that the Lithium salt.
- **Core-shell materials** are mainly obtained by synthesizing first the core material and then coating or synthesizing the shell materials over the core material.

SUPPLY CHAIN POSITION - OVERVIEW

IP position of key patent assignees in the supply chain

* IP position of each companies has been evaluated from the IP leadership, Prior Art Strength Index and IP Blocking Potential of their patent portfolio in each supply chain segments.

IP position



Excel Database

with all patents analyzed in the report with technology segmentation

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This database allows multi-criteria searches and includes patent publication number, hyperlinks to the original documents, priority date, title, abstract, patent assignees, technological segments and legal status for each member of the patent family.

NMC Lithium Battery: Patent Landscape Analysis 2017



Family Number (FamPat Database)	Patent Number	Publication Date (mm-dd)	Original Document (PDF)	Applicant	Publication Date (mm-dd)	Earliest Priority Date of the Patent Family	Expiration Date (yyyy-mm-dd)	Action Taken	Current Legal Status	Current Patent Assignee(s)	Title	Abstract	Claims	Production Chain Position				Type of materials									
														Precursor Manufacturing	Material Manufacturing	Electrode Manufacturing	Battery using NMC	Only Non-modified NMC	NMC included in a list of different active materials	Modified NMC	Modified NMC-Cation substitution	Modified NMC-Anion substitution	Modified NMC-Anion substitution with -F	Modified NMC-Anion substitution with other anions	NMC mixed with Non-NMC materials	NMC mixed with LiMPO4	NMC mixed with LiMO4
5522916	US20110222916	2-23-2011	Open	US15/111-03	2-23-2011	11-03-2010	11-26-2024	LEGAL	PENDING		Paritive Lithium	Provided are a PROBLEMTO	claimed in: comparison		X					X	X						
5522916	JP20110222916	3-02-2011	Open	JP20110222916	3-02-2011	09-24-2010	09-24-2024	LEGAL	PENDING		Electrode	An electrode	What is		X				X	X							
5571615	WO20110222916	3-09-2011	Open	WOJP	3-09-2011	03-02-2010	03-02-2024	LEGAL	PENDING		Compari	A comparison with the				X			X								
5575150	FR20110222916	3-03-2011	Open	FR155	3-03-2011	09-02-2010	09-02-2024	LEGAL	PENDING		PROCE	The invention formation					X		X								
5575150	WO20110222916	3-09-2011	Open	WOFR	3-09-2011	09-02-2010	03-02-2024	LEGAL	PENDING		Method	The invention	Proceeded				X		X								
5543723	US20110222916	3-02-2011	Open	US15/	3-02-2011	09-23-2010	09-23-2024	LEGAL	PENDING		Compari	A comparite	claimed in: stratiform		X										X		
5543723	KR20110222916	3-07-2011	Open	KR20	3-07-2011	09-25-2010	09-25-2024	LEGAL	PENDING		Compari	Being			X									X			
5543580	US20110222916	3-02-2011	Open	US15/	3-02-2011	09-31-2010	09-31-2024	LEGAL	PENDING		Dry	A dry	claimed in:			X			X							X	
5543580	WO20110222916	3-09-2011	Open	WOUS	3-09-2011	09-02-2010	03-01-2024	LEGAL	PENDING		Dry	A dry	What is			X			X								
5552264	JP20110222916	3-02-2011	Open	JP201	3-02-2011	09-21-2010	09-21-2024	LEGAL	PENDING		Lithium	PROBLEMTO	paritive				X		X								
5552264	JP20110222916	2-23-2011	Open	JP201	2-23-2011	09-21-2010	09-21-2024	LEGAL	PENDING		Lithium	PROBLEMTO	paritive				X		X								
5550207	FR20110222916	2-24-2011	Open	FR115	2-24-2011	01-27-2010	01-27-2024	LEGAL	PENDING		ELECTR	The invention with lithium					X		X								
5544425	US20110222916	3-02-2011	Open	US14/	3-02-2011	09-24-2010	09-24-2024	LEGAL	PENDING		Research	A process for	1.A process				X		X								
5544425	WO20110222916	3-02-2011	Open	WOUS	3-02-2011	09-24-2010	02-24-2024	LEGAL	PENDING		Research	A process for	1.A process				X		X								
5509104	CN10110222916	2-22-2011	Open	CN20	2-22-2011	11-07-2010	11-07-2024	LEGAL	PENDING		Nickel-	The present	cobalt		X			X									
5505290	CN10110222916	2-22-2011	Open	CN20	2-22-2011	11-04-2010	11-04-2024	LEGAL	PENDING		Silicon-	The present	voltage				X		X								
5501916	CN10110222916	2-22-2011	Open	CN20	2-22-2011	09-07-2010	09-07-2024	LEGAL	PENDING		H Method	The present	storage				X		X								
5493976	CN10110222916	2-22-2011	Open	CN20	2-22-2011	10-24-2010	10-24-2024	LEGAL	PENDING		Lithium-	The present	rate lithium-			X									X		
5469470	JP20110222916	2-16-2011	Open	JP201	2-16-2011	09-12-2010	09-12-2024	LEGAL	GRANTED		S The	The present	nanosquear				X		X								
5469470	WO20110222916	2-16-2011	Open	WOJP	2-16-2011	09-12-2010	02-12-2024	LEGAL	PENDING		S Nan-	The present	nanosquear				X		X								
5469457	JP20110222916	2-16-2011	Open	JP201	2-16-2011	09-10-2010	09-10-2024	LEGAL	PENDING		Nanoseq	PROBLEMTO	system				X		X								
5469457	JP20110222916	2-16-2011	Open	JP201	2-16-2011	09-06-2010	09-06-2024	LEGAL	PENDING		Product	PROBLEMTO	chemical				X		X								
5505290	CN10110222916	2-22-2011	Open	CN20	2-22-2011	11-04-2010	11-04-2024	LEGAL	PENDING		Silicon-	The present	voltage				X		X								
5501916	CN10110222916	2-22-2011	Open	CN20	2-22-2011	09-07-2010	09-07-2024	LEGAL	PENDING		H Method	The present	storage				X		X								
5493976	CN10110222916	2-22-2011	Open	CN20	2-22-2011	10-24-2010	10-24-2024	LEGAL	PENDING		Lithium-	The present	rate lithium-			X									X		
5469470	JP20110222916	2-16-2011	Open	JP201	2-16-2011	09-12-2010	09-12-2024	LEGAL	GRANTED		S The	The present	nanosquear				X		X								
5469470	WO20110222916	2-16-2011	Open	WOJP	2-16-2011	09-12-2010	02-12-2024	LEGAL	PENDING		S Nan-	The present	nanosquear				X		X								
5469457	JP20110222916	2-16-2011	Open	JP201	2-16-2011	09-10-2010	09-10-2024	LEGAL	PENDING		Nanoseq	PROBLEMTO	system				X		X								
5469457	JP20110222916	2-16-2011	Open	JP201	2-16-2011	09-06-2010	09-06-2024	LEGAL	PENDING	TOYOTA MOTOR	Product	PROBLEMTO	chemical														

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ORDER FORM

NMC Lithium-ion batteries: Patent Landscape Analysis (July 2017)

Ref.: KM17008

SHIP TO

Name (Mr/Ms/Dr/Pr):

Job Title:

Company:

Address:

City:

State:

Postcode/Zip:

Country:

VAT ID Number for EU members:

Tel:

Email:

Date:

PAYMENT METHODS

Check

To pay your invoice using a check, please mail your check to the following address:

KnowMade S.A.R.L.
2405 route des Dolines, BP 65
06902 Valbonne Sophia Antipolis
FRANCE

Money Transfer

To pay your invoice using a bank money wire transfer please contact your bank to complete this process. Here is the information that you will need to submit the payment:

Payee: KnowMade S.A.R.L.
Bank: Banque populaire St Laurent du Var CAP 3000 - Quartier du lac- 06700 St Laurent du Var
IBAN: FR76 1560 7000 6360 6214 5695 126
BIC/SWIFT: CCBPFRPPNCE

Paypal

In order to pay your invoice via PAYPAL, you must first register at www.paypal.com. Then you can send money to the KnowMade S.A.R.L. by entering our E-mail address contact@knowmade.fr as the recipient and entering the invoice amount.

RETURN ORDER BY

E-mail: contact@knowmade.fr

Mail: KnowMade S.A.R.L. 2405 route des Dolines, 06902 Sophia Antipolis, FRANCE

PRODUCT ORDER

☐ €4,990 – Single user license*

☐ €5,990 – Corporate license

For price in dollars, please use the day's exchange rate. For French customer, add 20% for VAT.

All reports are delivered electronically in pdf format at payment reception.

**Single user license means only one person at the company can use the report. Please be aware that our publication will be watermarked on each page with the name of the recipient and of the organization (the name mentioned on the PO). This watermark will also mention that the report sharing is not allowed.*

I hereby accept Knowmade's Terms and Conditions of Sale

Signature:

Terms and Conditions of Sales

DEFINITIONS

“Acceptance”: Action 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 Knowmade’s Terms and Conditions of Sale”.

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

“Contracting Parties” or “Parties”: The Seller on the one hand and the Buyer on the other hand.

“Intellectual Property Rights” (“IPR”) means any rights held by the Seller in its Products, including any patents, trademarks, registered models, designs, copyrights, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights or similar in any part of the world, notwithstanding the fact that they have been registered or not and including any pending registration of one of the above mentioned rights.

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

1. One user license: a single individual at the company can use the report.

2. Multi user license: the report can be used by unlimited users within the company. Subsidiaries are not included.

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

“Seller”: Based in Sophia Antipolis (France headquarters), Knowmade is a technology intelligence company specialized in the research and analysis of scientific and technical information. 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

1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. ANY ADDITIONAL, DIFFERENT, OR CONFLICTING TERMS AND CONDITIONS IN ANY OTHER DOCUMENTS ISSUED BY THE BUYER AT ANY TIME ARE HEREBY OBJECTED TO BY THE SELLER, SHALL BE WHOLLY INAPPLICABLE TO ANY SALE MADE HEREUNDER AND SHALL NOT BE BINDING IN ANY WAY ON THE SELLER.

1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorized person representing the Buyer. For these purposes, the Buyer accepts these conditions of sales when signing the purchase order which mentions “I hereby accept Knowmade’s Terms and Conditions of Sale”. This results in acceptance by the Buyer.

1.3 Orders 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 been accepted.

2. MAILING OF THE PRODUCTS

2.1 Products are sent by email to the Buyer:

- within [1] month from the order for Products already released; or

- 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.

2.2 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 Products.

2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.

2.4 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.

2.5 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.

2.6 No return of Products shall be accepted without prior information to the Seller, 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. The prices may be reevaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.

3.2 Payments due by the Buyer shall be sent by cheque payable to Knowmade, PayPal or by electronic transfer to the following account:

Banque populaire St Laurent du Var CAP 3000 - Quartier du lac- 06700 St Laurent du Var

BIC or SWIFT code: CCBPFRPPNCE

IBAN: : FR76 1560 7000 6360 6214 5695 126

To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.

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 latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the «BCE» + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.

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 Buyer 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 interpretations 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 (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement

4.3 In no event shall the Seller be liable for:

a) damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller’s website or the Products, or any information provided on the website, or in the Products;

b) any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.

4.4 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 cannot be guaranteed to be free from errors.

4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting 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.

4.6 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 any event as set out in article 5 below.

4.7 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 orders, except for non-acceptable delays exceeding [4] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 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 shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

5. FORCE MAJEURE

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, and not the fault of the Seller.

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 agreed 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 solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:

- Information storage and retrieval systems;

- Recordings and re-transmittals over any network (including any local area network);

- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;

- Posting any Product to any other online service (including bulletin boards or the Internet);

- Licensing, leasing, selling, offering for sale or assigning the Product.

6.3 The Buyer shall be solely responsible towards 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 respect of the copyrights and will guaranty 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 or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also 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

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

Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party.

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) entered into in application of these Terms and Conditions shall be settled by the French Commercial Courts of Grasse, which shall have exclusive jurisdiction upon such issues.

9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.



www.knowmade.com

contact@knowmade.fr

KnowMade S.A.R.L., 2405 route des Dolines, CS 10065, 06902 Sophia Antipolis, France

WHAT WE DO

KNOWMADE OFFERS YOU THE CAPABILITY TO

- **Understand** your competitive environment
- **Follow** technology trends
- **Find out** opportunities and threats
- **Strategize** your IP and R&D
- **Monetize** your technologies and know-how
- **Defend** your business

KNOWMADE OPERATES IN THE FOLLOWING SECTORS

Microelectronics | Compound Semiconductors | Power Electronics | RF & Microwave Devices
| LED/OLED | Imaging & Display | MEMS Sensors & Actuators | Photonics | Battery |
Manufacturing & Advanced Packaging | Micro & Nanotechnology | Biotechnology | Cellular &
Molecular Biology | Microbiology | Dermatology | Pharmacology | Oncology | Immunology |
Medical Devices & Medical Imaging | Agri-Food & environment



Patents
Technologies
Prior art
Scientific findings
Opportunities
Partners
Competitors
Newcomers
M&A targets

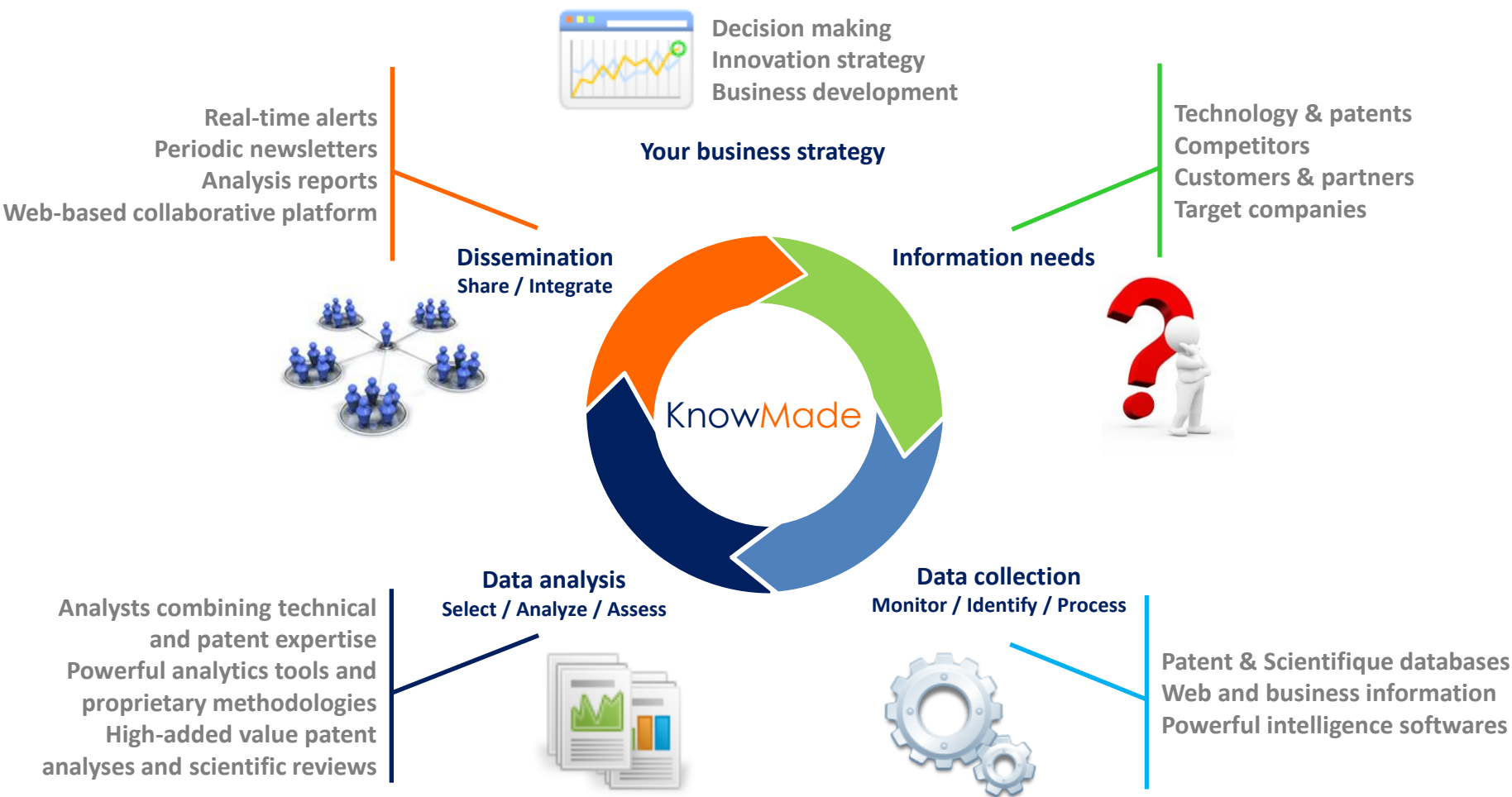


Patent landscape analysis
Scientific review
IP portfolio assessment
Patent valuation
Freedom-to-operate analysis
Litigation & licensing support
Patents linked to products
Technology scouting
Technology trends
Competitive IP landscape
Market trends
Reverse engineering

Make strategic decisions
Sustain competitive advantages
Speed R&D and enhance innovation process
Align R&D and IP with key business objectives
Strengthen IP portfolio and acquire technologies
Anticipate risks and defend core businesses
Explore new opportunities and monetize IP

INTELLIGENCE CYCLE

Tracking key technologies and competitors' R&D activities in order to anticipate changes, early detect business opportunities, mitigate risks, and make strategic decisions



CLIENT BENEFITS

Understand

your competitive environment from technology and patent perspective

- Identify risks & opportunities
- Understand technology & market from a patent perspective
- Discover new markets & technology direction
- Understand the competitive landscape
- Know where your competition is headed
- Identify your current and future competitors
- Understand your competitors' strategic direction and future product offerings
- Determine your competitors' strengths and weaknesses
- Identify strategic partnerships
- Identify untapped areas and opportunities to direct R&D and patenting activity

Strategize

your R&D and IP portfolio

- Speed your R&D and enhance your innovation process
- Sustain competitive advantages
- Protect your core technologies from competitors
- Anticipate the risks
- Assess your IP portfolio and competitive positions
- Realize the full value of your IP portfolio
- Explore new opportunities
- Strengthen your IP position
- Align your R&D and IP portfolio with key business objectives
- Leverage your IP portfolio to make strategic business decisions
- Identify new revenue opportunities
- Mitigate litigation risks

Build

an effective R&D and IP portfolio

- Strengthen your IP portfolio
- Acquire technologies and know-how
- Optimize your patent prosecution budget
- Improve your patent application process

Defend

your business

- Protect key markets and products by leveraging your IP to address competitive threats
- Defend your position in licensing negotiations or patent litigation

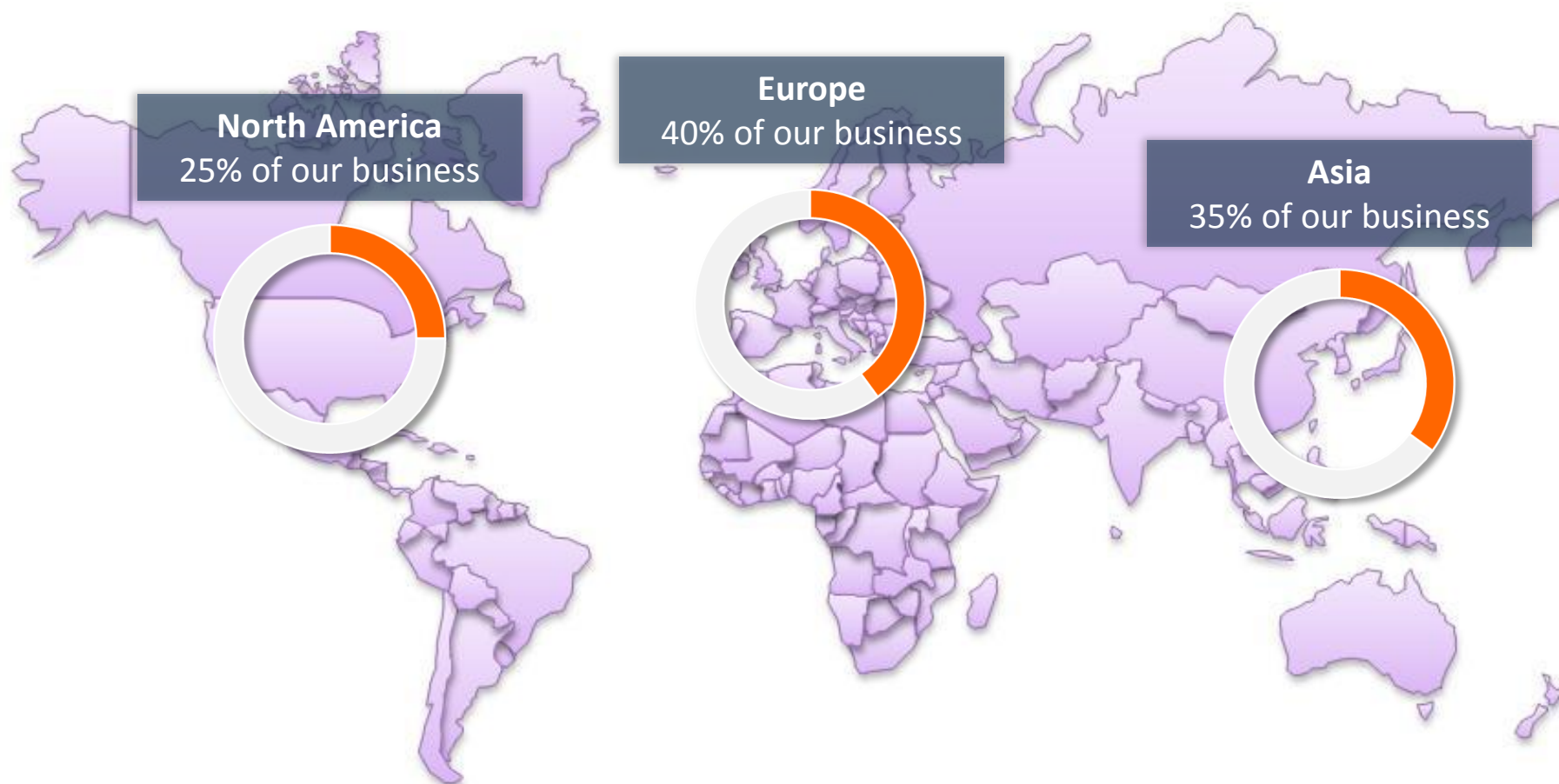
Monetize

your IP portfolio

- Turn your IP portfolio into valuable asset
- Assert your patent rights
- Develop successful patent sales or licensing program
- Improve your position in licensing negotiations or patent litigation

OUR GLOBAL ACTIVITY

- With an established base of more than 100 customers worldwide, Knowmade benefits from a global perspective of innovative technologies.
- Headquartered in Sophia Antipolis, France, our services are offered worldwide with the support of distributors.



PARTNERS



YOLE DEVELOPPEMENT

Market, technology and strategy consulting

Yole Développement is a strategy consulting and market research company. The company provides marketing, technology and strategy analysis, with a strong focus on emerging applications using silicon and/or micro manufacturing.

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SYSTEM PLUS CONSULTING

Manufacturing costs analysis - Teardown and reverse engineering

System Plus Consulting is specialized in technology and cost analysis of electronic components and systems. Cost models and technology expertise are combined to provide customers with an accurate and objective estimation of manufacturing costs and selling prices.

www.systemplus.fr



BLUMORPHO

Innovation accelerator

Blumorpho drives the last mile to turn innovative technologies into successful business. The company focus on reducing the technological, market and financial risks of adopting or exploiting innovation. Blumorpho's market place stores a portfolio of 200 innovations, 44.000 corporate contacts, 7.400 startups and 800 investors, as well as 20 years' technology and market expertise.

www.blumorpho.com



PISEO

Qualification of smart optical systems

PISEO is an independent technical center dedicated to LED based light systems covering the UV, visible and IR spectrum. It brings together in a single entity high skilled engineers and advanced technical testing equipment.

www.piseo.fr

STANDARD REPORTS

« Pre-packaged » analysis

Knowmade team of experts work all year long to **collect patent** and **scientific information**, **identify** and **analyze** the **trends**, the **challenges**, the **emerging technologies**, the **competitive environments**, and turn it into results to give you a **complete picture** of your **industry landscape**.

Each year, **Knowmade** publishes a comprehensive **collection of reports** in various technology fields. These **fact-based analyses** can provide you with the reliable information you need to advance your **business** and your **competitive position**.

TYPE OF REPORT	CONTENT												
	Competitive IP landscape	IP trends	Key patents	Key IP players	IP strategy	IP collaboration network	Licensing agreements	Patent legal status	Patent Litigation	Patent database	Risk assessment	Market trends	Reverse engineering
Patent Landscape Analysis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Patent-to-Product Mapping			✓	✓	✓	✓	✓	✓	✓	✓			✓
Patent Infringement Risk Analysis			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Patent Portfolio Analysis			✓		✓	✓	✓	✓	✓	✓			
Patent Watch (monthly updated)		✓	✓	✓				✓	✓	✓			

STANDARD REPORTS

Report collection 2017

COMPOUND SEMICONDUCTORS

- GaN Substrate – Patent Landscape 2017*
- Patent Trolls in the Semiconductor Market – Litigation Risk and Potential Targets 2017
- GaN Technology – Top-100 IP Profiles 2016
- GaN Devices for Power Electronics – Patent Landscape 2015
- GaN-on-Silicon Substrate – Patent Landscape 2014
- GaN Substrate – Patent Landscape 2014
- FD-SOI – Patent Landscape 2014

POWER ELECTRONICS

- GaN Devices for Power Electronics – Patent Landscape 2015

RF DEVICES & TECHNOLOGIES

- RF Acoustic Wave Filters (SAW, BAW, FBAR/SMR) – Patent Landscape 2017*

LED

- Phosphors and QDs for LED Applications – Patent Landscape 2015
- Nanowire LED – Patent Landscape 2014

IMAGING

- Uncooled Infrared Imaging – Patent Landscape 2017*
- Consumer Physics SCiO Molecular Sensor – Patent-to-Product Mapping 2017
- Biomedical Photoacoustic Imaging – Patent Landscape 2015
- Honeywell Microbolometer – Patent Portfolio Analysis 2015
- Capsule Endoscopy – Patent Landscape 2014

MEMORY

- 3D Monolithic Memory – Patent Landscape 2017*
- Patent Trolls in the Semiconductor Market – Litigation Risk and Potential Targets 2017
- ReRAM and Memristor Technologies – Patent Landscape 2015
- Emerging Non-Volatile Memories (eNVM) – Patent Landscape 2014

BATTERY AND ENERGY MANAGEMENT

- NMC Lithium-ion Batteries – Patent Landscape 2017
- Microbattery – Patent Landscape 2016

MEMS SENSORS & ACTUATORS

- RF Acoustic Wave Filters (SAW, BAW, FBAR/SMR) – Patent Landscape 2017*
- Uncooled Infrared Imaging – Patent Landscape 2017*
- Pumps for Microfluidics – Patent Landscape 2017
- Knowles MEMS Microphones in Apple iPhone 7 Plus – Patent-to-Product Mapping 2017
- Microfluidic Technologies for Diagnostic Applications – Patent Landscape 2017
- Consumer Physics SCiO Molecular Sensor – Patent-to-Product Mapping 2017
- Miniaturized Gas Sensors – Patent Landscape 2016
- Microbattery – Patent Landscape 2016
- MEMS Microphone – Patent Infringement Risk Analysis 2015
- Capacitive Fingerprint Sensors – Patent Landscape 2015
- Honeywell Microbolometer – Patent Portfolio Analysis 2015
- 9-Axis MEMS IMU – Patent Infringement Risk Analysis 2014
- Emerging MEMS – Patent Landscape 2014

ADVANCED PACKAGING

- Hybrid Bonding for 3D Stack – Patent Landscape 2017*
- 3D Monolithic Memory – Patent Landscape 2017*
- Fan-Out Wafer Level Packaging – Patent Landscape 2016
- TSV Stacked Memory – Patent Landscape 2016

MEDTECH

- Pumps for Microfluidics – Patent Landscape 2017
- Microfluidic Technologies for Diagnostic Applications – Patent Landscape 2017
- 3D Cell Culture Technologies – Patent Landscape 2016
- Miniaturized Gas Sensors – Patent Landscape 2016
- Non-Invasive Glucose Monitoring – Patent Landscape 2015
- Biomedical Photoacoustic Imaging – Patent Landscape 2015
- Capsule Endoscopy – Patent Landscape 2014

** Coming soon*

Complete list of reports on www.knowmade.com

CUSTOM STUDY & CONSULTING

Tailor-made analysis to meet your needs and budgetary constraints

Prior art search

Evaluate the patentability of your invention in the course of a patent filing.
Invalidate competitor's patents in the course of patent litigation or in anticipation of one.
Make third-party observations concerning the patentability of competitor's inventions.

Patent landscape analysis

Understand the competitive environment and the technology trends from a patent perspective.
Identify key players, their IP strategy and their key patents.
Know IP collaborations, licensing agreements and litigation history.

Freedom-to-operate analysis

Assess the risks to infringe third-party patents.
Ensure that your products/processes can be safely manufactured, sold and used in specific countries without infringing patents held by others.

Litigation and licensing support

Evidence of infringement/non-infringement for offensive/defensive support.
Defend your position in licensing negotiation or patent litigation.



Patent assessment

Identify most valuable patents prior to patent acquisition/sales, licensing agreement, capital fundraising process, M&A or IP due diligence.
Estimate the financial value of your patent portfolio.

IP due diligence

Assess the patent portfolio of a company and reveal the SWOT matrix prior to patent acquisition/sale, licensing agreement or M&A.

Scientific literature analysis

Pinpoint key research findings and new emerging research fields, key laboratories and scientific experts, industrial/academic research collaborations, and identify prospective R&D partners.

Technology scouting

Identify, qualify and get access to external innovation.

Technology watch service

Follow technology trends, keep a watch on your competitors and identify new entrants, anticipate the changes, early detect business opportunities and mitigate the risks.

CUSTOM STUDY & CONSULTING

Tailor-made analysis to meet your needs and budgetary constraints

YOUR NEED	CUSTOM STUDY									
	Prior art search	Patent landscape analysis	Freedom-to-operate analysis	Patent-to-product mapping	Litigation & Licensing support	Patent assessment	IP due diligence	Scientific literature analysis	Technology scouting	Technology watch service
Understand the competitive landscape		✓	✓				✓	✓		
Know the key players and their key patents		✓	✓				✓	✓		
Follow the technology trends and identify emerging technologies		✓						✓		✓
Track competitors, their IP activity, strategy and future intents		✓		✓				✓		✓
Know your competitors' strengths and weaknesses		✓	✓			✓	✓	✓		
Early detect business opportunities		✓						✓		✓
Evaluate the patentability of your inventions	✓									
Invalidate competitors' patents	✓				✓			✓		
Prevent registration of critical patents from competitors	✓				✓					
Identify patents used in products				✓	✓	✓	✓			
Make evidence of patent infringement			✓	✓	✓					
Evaluate the risks to infringe someone else's patents			✓	✓	✓		✓			
Mitigate the risks of patent litigation		✓	✓		✓		✓			
Defend your position in licensing negotiation or patent litigation	✓		✓	✓	✓	✓				
Reduce the risks in M&A			✓			✓	✓			
Evaluate your real patent protection					✓		✓			
Benchmark patent portfolios		✓				✓	✓			
Identify the most valuable patents and estimate their financial value				✓		✓			✓	
Monetize your patents and identify potential licensees/buyers				✓	✓	✓				
Acquire technologies or identify potential licensors		✓		✓	✓	✓		✓	✓	
Speed your R&D and enhance your innovation process		✓						✓	✓	✓
Decrease R&D and IP costs	✓		✓		✓	✓			✓	
Identify free technologies which can be used safely		✓	✓						✓	
Identify key research laboratories and potential R&D partners		✓						✓	✓	

TRAINING & WORKSHOP

Benefit from face-to-face meeting with our experts

Training

Knowmade provides guidance to companies and research laboratories seeking to gain an understanding of the issues linked with competitive intelligence, set up an internal intelligence process or improve their existing processes.

- ✓ Patent information for R&D, strategy and marketing
- ✓ Patent Intelligence: Tapping the economic potential of patent information
- ✓ Technology Intelligence and Innovation
- ✓ Setting up a strategic intelligence unit
- ✓ Intelligence process optimization



Workshop

Objective

One day face-to-face presentation of our data and analysis with Q&A session on specific questions of your choice (direct interaction with our experts at your site)

- Have the ability to ask questions or for specific analysis before the workshop
- Access to Knowmade ongoing analyses
- Direct contact with Knowmade analysts
- Open Q&A session with the key persons of your company

Content

- ✓ Presentation of updated Knowmade analyses
- ✓ Presentation of the analysis done for your company
- ✓ Executive synthesis
- ✓ Q&A session and open discussion





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