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ABOUT KNOWMADE

Specialized in analysis of patents and scientific information, Knowmade provides Technology Intelligence and IP strategy consulting services. The company supports R&D organizations, industrial companies and investors in their business development by offering them a deep understanding of their IP environment and the technology trends.

Knowmade operates in the following industrial sectors: Compound Semiconductors, Power & RF/microwave Electronics, LED/OLED Lighting & Display, Photonics, Memories, MEMS & Sensors, Manufacturing & Advanced packaging, Batteries & Energy management, Biotechnology, Pharmaceuticals, Medical Devices, Medical Imaging, Agri-Food & Environment.

Knowmade’s 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’s analysts combine their technical and patent expertise by using powerful analytics tools and proprietary methodologies to deliver relevant patent analyses and scientific reviews.
**Scope of the report**

- This report provides a detailed picture of the patent landscape for LiDAR dedicated to automotive applications.
- This report covers patents published worldwide up to September 2017. We have collected and analyzed more than 12,950 patents and patent applications grouped in more than 6,480 patent families relevant to the scope of this report.

<table>
<thead>
<tr>
<th>Example</th>
<th>Lidar devices and systems</th>
<th>Lidar applications</th>
<th>Excluded</th>
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<tr>
<td>Generic patents describing lidar devices without describing any specific applications</td>
<td>X</td>
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<tr>
<td>Patents describing elements or optical compound especially dedicated for lidar systems</td>
<td>X</td>
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<tr>
<td>Patents describing lidar driving systems</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Patents describing methods for driver assistance systems</td>
<td>X</td>
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<tr>
<td>Patents claiming the use of LiDAR, RADAR, and other sensors in anti-collision and other ADAS systems</td>
<td>X</td>
<td></td>
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<tr>
<td>Patents describing non-removable lidar for vehicle traffic surveillance</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Patents describing lidar system for airborne, weather, laser guidance, industrial, robotic, or satellite applications</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patents describing laser, optical components, detectors, etc., and non-directly related to lidar applications</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**Include in the report as LiDAR devices and systems**
- Lidar component
- Lidar optical system
- Lidar system in vehicle

**Include in the report as LiDAR applications**
- ADAS system using lidar
- 3D and environment mapping

**Not included in the report**
- ...
Understanding of the main trend
Who, When and Where?

IP Landscape Overview
Time evolution of patent publications

IP landscape overview
Geographic map of patent applications

IP Landscape Overview
Main applicants of LiDAR related patent families

IP landscape overview
Mapping of main IP holders
Understanding the IP position of main assignee

IP dynamic and status of each assignee
Analysis by segment
Segment overview and main IP players identification
Comparison of IP players
Who has the strongest portfolio related to the segment and why?

Leadership

Blocking

Reinforcement
Key technologies
Overview of each promising IP segments and illustration of main solutions

Key technologies
Sub-segmentation methodology

To identify and analyze the main technological key patents, we have chosen to sub-segment the lidar systems and components by key technological bricks. The segmentation includes patents related to:

- laser flight emission with a focus on laser diodes and VCSEL technologies
- reflected light sensors including single photon avalanche diode (SPAD), CMOS image sensors (CCD camera, etc.) and photodetectors
- Scanning mechanisms with a focus on micro mirrors / MEMS solutions and classic scanning solution (rotating mirrors)

Emission
- Laser diode
- VCSEL
- LED

Reception
- CMOS image sensors /CCD
- SPAD
- Photodiode / APD

Scanning systems
- Micro mirrors
- Flash
- Scanning
Key patent families
Identification of seminal and blocking patent families
Newcomers portfolio analysis
Understanding of newcomers patented technologies and IP strategy
Main IP players portfolio analysis
Identification of main IP players position and current IP strategies
This Excel database allows multi-criteria searches and includes patent publication number, hyperlinks to the original documents, priority date, title, abstract, patent assignees, legal status and technical segment for each patent families.
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Product Description: A statement of the characteristics of the Product.
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1.3 Only acts or omissions not 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.

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2.7 The Buyer is bound to the Product 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.
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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 Seller may suspend the delivery of the Products and remove the contracts based on the annual rate of Ref of the «Euros + 7 points, in accordance with Article L 441-6 of the French Commercial Code. Our publications (report, database, tool...)
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4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or any event as a material breach of this agreement.
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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 are not intended to be exhaustive.
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- to enable any other person (including business rivals or the internet); - licensing, leasing, selling, offering for sale or assigning the Product.

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- use in any timesharing, service bureau, bulletin board or similar arrangement or public display;
- to enable any other person (including business rivals or the internet); - licensing, leasing, selling, offering for sale or assigning the Product.
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9.2 If French laws shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.
**Executive team**

**Dr. Nicolas Baron**
CEO and co-founder of Knowmade.
He manages the development and strategic orientations of the company and personally leads the Electronics & Telecom department. He holds a PhD in physics from the University of Nice Sophia-Antipolis, and a Master degree in Intellectual Property Strategies and Innovation from the European Institute for Enterprise and Intellectual Property (IEEPI Strasbourg), France.

**Dr. Brice Sagot**
CTO and co-founder of Knowmade.
He manages the development of IP analysis tools and methodologies, and personally leads the Life Sciences & Healthcare department. He holds a PhD in molecular biology from the University of Nice Sophia-Antipolis, France.

**Analyst team**
7 full time analysts with PhD degree and in-depth knowledge in Intellectual Property and Scientific Information.
WHAT WE DO

KNOWMADE OFFERS YOU THE CAPABILITY TO
✓ Understand your competitive environment
✓ Follow technology trends
✓ Identify patent/technology opportunities
✓ Assess patent/technology risks
✓ Strategize your IP and R&D
✓ Monetize your technologies and know-how
✓ Defend your business

KNOWMADE OPERATES IN THE FOLLOWING SECTORS
❖ Semiconductors
  Compound semiconductors, Power & RF electronics, LED lighting & display, Photonics, Memories, Advanced packaging
❖ MEMS, Sensors & Actuators
  Inertial sensor, Microphone & Microspeaker, RF switch, filter & resonator, Environmental sensor, Optical sensor & actuator, Microfluidics, Microfabrication technologies
❖ Batteries & Energy Management
  Energy storage, Battery cell & pack, Power electronics, Renewable energies
❖ MedTech
  Biotech, Pharma, Medical devices, Medical imaging

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

Semiconductors
- Compound semiconductors
- Power & RF electronics
- LED lighting & display
- Photonics
- Memories
- Advanced packaging

MEMS, Sensors & Actuators
- Inertial sensor
- Microphone & Microspeaker
- RF switch
- Filter & resonator
- Environmental sensor
- Optical sensor & actuator
- Microfluidics
- Microfabrication technologies

Batteries & Energy Management
- Energy storage
- Battery cell & pack
- Power electronics
- Renewable energies

MedTech
- Biotech
- Pharma
- Medical devices
- Medical imaging
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

---

INTELLIGENCE CYCLE

1. **Decision making**
   - Innovation strategy
   - Business development

2. **Information needs**
   - Technology & patents
   - Competitors
   - Customers & partners
   - Target companies

3. **Dissemination**
   - Share / Integrate

4. **Data collection**
   - Monitor / Identify / Process

5. **Data analysis**
   - Select / Analyze / Assess

6. **Real-time alerts**
   - Periodic newsletters
   - Analysis reports
   - Web-based collaborative platform

7. **Analysts combining technical and patent expertise**
   - Powerful analytics tools and proprietary methodologies
   - High-added value patent analyses and scientific reviews

8. **Powerful intelligence softwares**
   - Patent & Scientifique databases
   - Web and business information
   - Powerful intelligence softwares

KnowMade
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
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.

IP & Technology watch service
Follow IP/technology trends, keep a watch on your competitors and identify new entrants, anticipate the changes, early detect business opportunities and mitigate the risks.
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<th>COMPOUND SEMICONDUCTORS</th>
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<td>• Power SiC - Patent Landscape 2018*</td>
<td>• TSV Stacked Memories - Patent Landscape 2016</td>
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<td>• Emerging Non-Volatile Memories (eNVM) - Patent Landscape 2014</td>
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<td>• Solid-state Batteries - Patent Landscape 2018*</td>
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<tr>
<td>• GaN Devices for Power Electronics - Patent Landscape 2015</td>
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- Setting up a strategic intelligence unit
- Intelligence process optimization

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Objective
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➢ 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