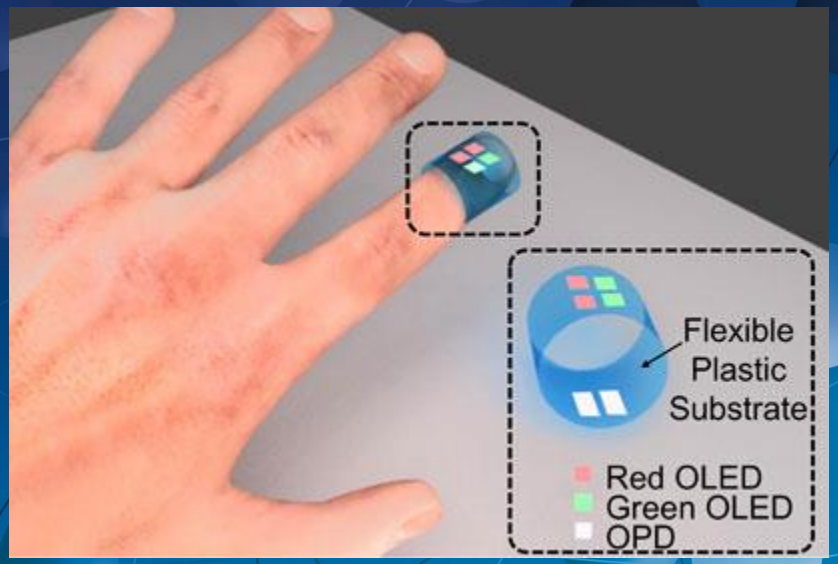
Sensor Technology (TechVision)



Optoelectronic Sensors

D727-TV

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FROST & SULLIVAN

Contents

Sensor Technology Innovations in Optoelectronic Sensing

Quantum Film Image Sensor

InVisage

Tech. Profile

A thin film made of quantum dots is placed below the micro lens of the image sensor, which enables the sensor to capture approximately four times more light than conventional image sensors. The mechanism allows the sensor to operate a true global shutter, that is, the entire scene is captured in an instant.

Wide-scale Adoption

The company is primarily focused on the mobile devices market where the size of the device is a major pain point for integrating advanced imaging systems.

Market Opportunity

- ✓ Smartphones/tablets
- ✓ Security and Surveillance
- ✓ Professional Photography

Competing Aspects

- ✓ Small Form Factor
- ✓ High Sensitivity
- ✓ High Fill Factor
- ✓ Instant Shutter

Technology Convergence

Image sensors can be used for multiple biometric applications, such as iris scanning, face scanning, and fingerprint scanning. Biometrics is being widely adopted in various applications, such as, mobile authentication, population enrolling, and passports.

Innovation Attributes

- ✓ Achieves 100% fill factor as no light bounces off from conventional metals.
- ✓ Enables thinner camera modules, allowing thinner smartphones
- ✓ Instant shutter instead of rolling shutter

Market Entry Strategies

The latest funding round of $32.5 million includes investment from GGV Capital, China Oceanwide USA Holdings, Nokia Growth Partners, Interwest Partners, Intel Capital and RockPort Capital. InVisage is planning to partner with major foundries.

Image sensor architecture to maximize light sensing capabilities

Three Pixel Sensor

Rice University

Tech. Profile

Rice University has developed a three pixel prototype sensor to capture images by using two dimensional compound of Copper Indium and Selenide (CIS) atoms. The researchers have fabricated CIS on a silicon substrate. On top of the CIS, three pairs of titanium/gold electrodes are fabricated and cut into three sections with a focused ion beam.

Wide-scale Adoption

This material is an important component in two-dimensional electronics that capture images. The researchers are looking to enable more applications using image capturing devices. The sensor is expected to be commercialized in one year's time.

Market Opportunity

- ✓ Flat Imaging Devices
- ✓ Biomedical
- ✓ Electronic Camera lenses

Competing Aspects

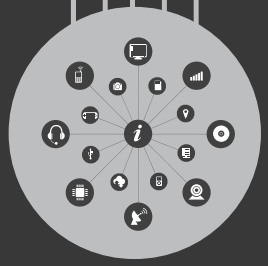
- ✓ Efficient
- ✓ Thin
- ✓ Transparent
- ✓ Flexible

Technology Convergence

Optoelectronic sensors can converge with various technologies, such as, image sensing, robotics, energy harvesting, and advanced materials (for instance, nanostructured materials).

Innovation Attributes

CIS pixels are highly sensitive to light and ten times more efficient than other materials such as chalcogenide compounds and molybdenum disulfide.



Market Entry Strategies

The university is expected to look out for collaborations with industry partners in the consumer electronics domain. At present, the university's main focus is consumer electronics but it is also open to partnerships with companies in the medical sector.

Technology Readiness Level: 1 2 3 4 5 6 7 8 **9**

Micro Thermal Imaging Sensor

Flir

Tech Profile	Competing Aspects	Innovation Attributes	Market Entry Strategies
US-based FLIR systems has come up with a microthermal imaging camera core, which will enable thermal imaging to be incorporated in small mobile devices such as smartphones. The system is known as the FLIR ONE smartphone accessory.	○ Small Form Factor ○ Night Vision ○ Uncooled ○ High Image Quality	✓ Thermal imaging capabilities in mobile consumer devices. ✓ FLIR has used various proprietary technologies, such as wafer level detector packaging and micro-optics, that have resulted in the small form factor of the core.	○The company is targeting security-based applications. In addition, it is planning to increase its database by acquiring or partnering with companies involved in security and surveillance.

Technology Readiness Level 1 2 3 4 5 6 7 8 **9**

Impact & Opportunities

Wide-scale Adoption

✓Cost efficiency will help the company to get down to the mass market acceptable price levels.

Market Opportunity

✓Consumer Electronics
✓Security and Surveillance
✓Building and Automation
✓Industrial Machine Vision
✓Automotive

Application Landscape

✓Optoelectronic sensors are widely used for security and surveillance applications, including night vision, law enforcement, and fire fighting. Non destructive infrared technology is used for gas detection, which can be used for worker safety purposes. These sensors are also used for environment sensing.

Flexible Pulse Oximeter Sensor

University of Berkeley

Tech. Profile

- The device is comprised of red and green OLED, and a photodiode to detect light. By identifying the pattern of arterial blood, the device can be used to measure the pulse rate.
- Spin coating technique has been employed to deposit the layer of sensors and OLED on organic flexible substrate

Competing Aspects

- Low Cost
- Flexible
- Disposable
- Accurate

Technology Readiness Level

Innovation Attributes

✓ The sensors can easily conform to the body
✓ Thin, flexible and cheap to manufacture sensors

Market Entry Strategies

- The project was funded by Flex Tech and National Science Foundation.
- The main focus area for the university is the medical domain. The university is expected to get into partnership agreements with companies operating in the medical domain.

Impact & Opportunities

Wide-scale Adoption

✓It is expected to be commercialized in one year's time
✓.The sensor has potential to be well received in the healthcare sector as it is easy to use, thin, flexible, and cost efficient; moreover, it can be disposed of easily if the device is contaminated.

Market Opportunity

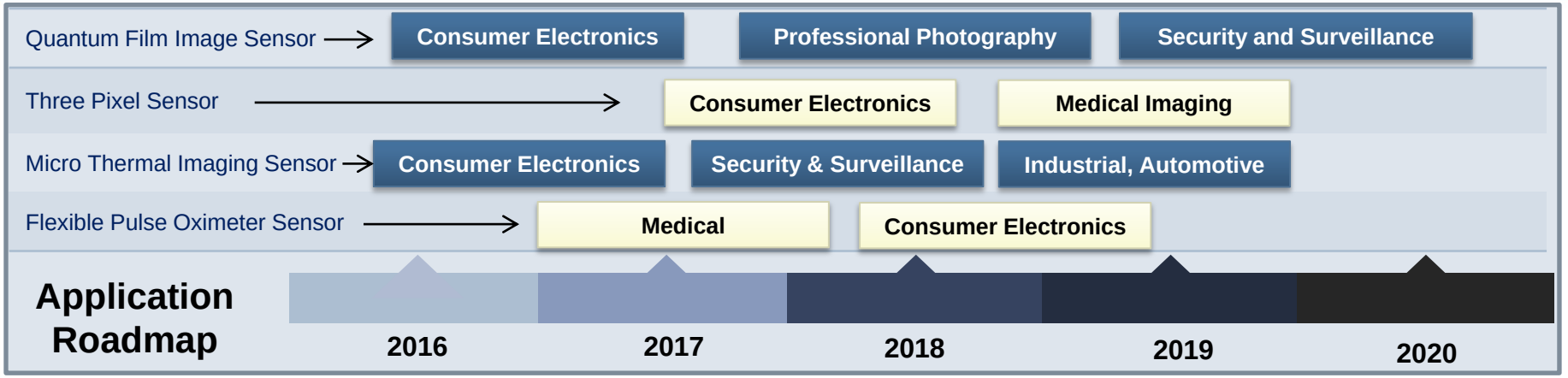
The technology will be driven by trending market applications including:
✓Health & Wellness
✓Quantified Self
✓Wearable Electronics
✓Connected Living

Technology Convergence

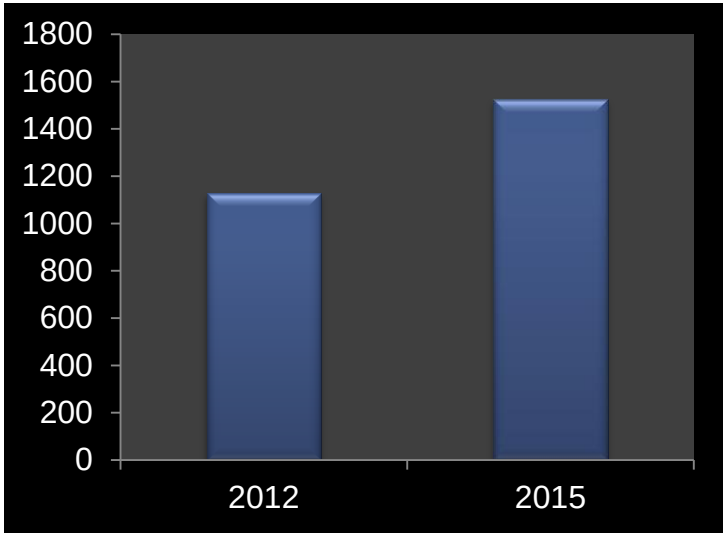
✓Light can be used for transmitting data that can be used for next-generation wireless communications.

Strategic Insights

Strategic Insights



Intellectual Property (IP)



- The data includes patents on image sensors, thermopile sensors, fiber optic sensors, infrared sensors, ultraviolet sensors and image sensors.
- Key Patent holders, such as Lockheed Martin Corporation, Corning Cable System LLC, and Samsung Electronics Co. Ltd., are set to capture the optoelectronics market aggressively and have compiled intensive patent portfolios through in-house R&D, acquisitions and cross licenses.
- Small participants seem to be flourishing in the niche spaces– LIDAR, and visible light communication.
- The US leads in the number of patents published in optoelectronic sensors.

Strategic Insights

Drivers

- ✓ Design Flexibility
- ✓ Low-power consumption
- ✓ Lifetime
- ✓ New product development
- ✓ Strong R&D efforts
- ✓ High Application Scope
- ✓ Untapped Materials
- ✓ Technology advancements

Restraints

- Ẋ Though LEDs and image sensors are likely to be cost effective in the long term, their initial input costs will be high.
- Ẋ Compatibility of materials
- Ẋ Scalability

Focus Areas

- Communication
- Optical Memory
- Lighting
- Display
- Sensors
- Medical
- Optical Energy

Funding

- Developing economies are investing heavily in optoelectronic devices. Government funding is focused primarily on emerging technologies while more R&D on more mature technologies are being done by major corporates.
- The European Commission is actively funding various projects, including:
  - Perovskite-based Hybrid Optoelectronics (Project cost – about $ 223,000)
  - Revolutionary Advances in Photonics Integration Being Applied for Optical Communication (Project cost – about $5 Million)
  - Low-temperature chemical approaches to novel materials based on earth abundant elements - Towards advanced electronic and optoelectronic applications (Project cost – about $112,000)

The 2020 Scenario

- ❑ Sensing light has various applications in automation, imaging, security, and surveillance. Optoelectronic sensors have a huge market potential in the near to long term. The market is at a relatively mature stage and higher penetration in applications, such as, ambient light sensing for building automation, and image sensors for automobiles are expected. Fiber optic sensors are also a key segment in optoelectronics sensors, with growth opportunities in such areas as distributed temperature and strain sensing. Light will be used in transmitting data which will further enable next-generation wireless communication such as Li-Fi.

Key Patents and Industry Interactions

Key Patents

No.	Patent No.	Publication Date	Title	Assignee
1	**WO/2016/013977**	28.01.2016	OPTOELECTRONIC MODULES INCLUDING AN IMAGE SENSOR HAVING REGIONS OPTICALLY SEPARATED FROM ONE ANOTHER	HEPTAGON MICRO OPTICS PTE. LTD.
	This disclosure describes optoelectronic modules that include an image sensor having at least two regions separated optically from one another by a wall. The wall can include a bridge portion that extends over the image sensor and further can include a cured adhesive portion, part of which is disposed between a lower surface of the bridge portion and an upper surface of the image sensor. Various techniques are described for fabricating the modules so as to help prevent the adhesive from contaminating sensitive regions of the image sensor. The wall can be substantially light-tight so as to prevent undesired optical cross-talk, for example, between a light emitter located to one side of the wall and a light sensitive region of the image sensor located to the other side of the wall.			
2	**US20150268067**	24.09.2015	OPTOELECTRONIC SENSOR FOR DETECTING ONE OR MORE FEATURES OF AN OBJECT	DATALOGIC IP TECH S.R.L
	An optoelectronic sensor for detecting one or more features of an object comprises means for controlling the operation of said sensor and a face (20) for interaction with an operator provided with adjusting means (22, 23) for adjusting operating parameters of the sensor. The means for controlling is connected to the adjusting means (22, 23) to detect a setting of the operating parameters and the adjusting means (22, 23) comprises a knob (22) which is rotatable around an axis (A) for adjusting at least one predetermined parameter among said operating parameters. The sensor comprises a multiturn encoder (28) that is actuatable by the knob (22) and the means for controlling are connected to the multiturn encoder (28) to obtain a rotation mode of said knob, for example a rotation direction and further/or a rotation speed, so as to associate with said detected rotation mode a corresponding setting mode of the predetermined parameter, for example a setting with a first coarse sensitivity, or a second fine sensitivity.			

Key Patents (continued)

No.	Patent No.	Publication Date	Title	Assignee
3	**US20150177368**	25.06.2015	OPTOELECTRONIC SENSOR DEVICE, IN PARTICULAR LASER SCANNER, HAVING AN ADAPTED RECEIVING UNIT FOR OPTIMIZED REDUCTION OF THE RECEPTION LEVEL	VALEO Schalter und Sensoren GmbH
	The invention relates to an optoelectronic sensor device (1) for a motor vehicle, for detecting objects located in the surroundings of the motor vehicle, having a transmitting unit (2) for emitting an optical transmission signal (5), having a receiving unit (7) for receiving a reception signal (8) which is the transmission signal (5) reflected by an object, wherein the receiving unit (7) has at least two receiving elements (9, 10, 11) which are arranged distributed along a distribution direction (12), and reception optics (13), in particular a receiving lens which is positioned ahead of the receiving elements (9, 10, 11) in the propagation direction (14) of the reception signal (8), having a securing device (22) for securing the receiving optics (13), and having a diaphragm (21, 21′) for reducing the intensity of the reception signal (8), wherein the diaphragm (21, 21′) is secured to the securing device (22).			
4	**JP2015034964**	19.02.2015	TRANSPARENT RESIN LAYER-FORMING COMPOSITION, TRANSPARENT RESIN LAYER, SOLID-STATE IMAGE SENSOR, AND OPTOELECTRONIC DEVICE	FUJIFILM CORP
	PROBLEM TO BE SOLVED: To provide a transparent resin layer-forming composition which offers superior patterning performance with a photolithographic method, is less susceptible to being colored during heat treatment, and is capable of forming thick transparent resin layers, and to provide a transparent resin layer, a solid-state image sensor, and an optoelectronic device. SOLUTION: A transparent resin layer-forming composition contains a polymerization initiator having a molar absorption coefficient (ε) of no greater than 1000 mol-1 L cm-1 at a wavelength of 365 nm, a polymerizable compound, a polymer, and a solvent. The polymerization initiator shall preferably be at least a compound selected from a group comprising α-hydroxyacetophenone compounds and phosphine compounds. COPYRIGHT: (C)2015,JPO&INPIT			

Industry Interactions

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