TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

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1. WEARABLE REFLECTIVE SENSORS

Wearable electronics are the future of healthcare and medical devices. Sensors are gaining strong traction in wearable electronics. Reflective pulse oximetry devices available in the market are unable to measure blood saturation in various parts of the body and pulse rate because of the weak reflective signals caused by interference from strong noises. However, the pulse oximetry device continuously attached to the fingertip to monitor pulse rate can cause pain and might lead to tissue breakdown. There is a need for an easy-to-use device which can provide a reflective signal with good strength. This modulated or high-power signal should be further able to achieve accurate and efficient results.

To address the above challenge, researchers from Taiwan Biophotonic Corporation have developed a non-invasive and wearable sensing device for medical devices and healthcare. The wearable device is an optical reflective pulse oximetry sensor.

Taiwan Biophotonics' optical reflective pulse oximetry device is integrated with infrared, green and red light emitting diodes (LEDs), photodiode and microstructured optical element. A microstructured optical element is deployed to modulate propagation of photons within skin tissue. The device is deigned to consume 5 milliamps of power. The optical reflective pulse oximetry device is attached to the skin surface, which further helps to emit the incident light and detect the reflective light on the same side. The optical element in the sensor is used to enhance the reflective light and reduce stray light noise; which further helps to reduce the noise-to-signal ratio. Thus, the device is able to measure blood oxygen in various parts of the body and also measure the pulse rate.

Once commercialized, the device will be used as a wearable device for medical applications. During human trials conducted by Taiwan Biophotonic Corporation, it was found that the accuracy of the optical reflective pulse oximetry device closely matches medical grade specifications.

The project was supported by Industrial the Technology Research Institute (ITRI) and it is self-funded by Taiwan Biophotonic Corporation. The researchers are currently working on enabling different products based on the same technology.

The device is expected to be commercialized in one to two years' time. Once the device is successfully commercialized, it is expected to be well received in the healthcare sector as it is easy to use, and does not harm skin tissues. Moreover, it enhances the reflective light and reduces noise-to-signal ratio.

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2. WIRELESS BRAIN SENSORS

Neuro transmitters and brain sensors transmit vast amounts of data continuously. The current sensors and transmitters available in the market are powered with the help of cables, which further tether the subject. There is a need for a device that can transmit and read the signal wirelessly. The device should be able to transmit all the meaningful information about subjects when they are sleeping and awake. The device should be able to provide accurate information and withstand long-term battery use.

To address the above challenge, researchers from Brown University have developed a wireless neuro sensor for neuro-electronic platforms to transmit vast amounts of data continuously and wirelessly.

The neuro electronic platform structure consists of two elements--a transmitter and a receiver. The transmitter weighs 46.1 grams and consists of 100 channels 5 centimeters in dimension. A receiver consists of four antennas' for sophisticated signal processing. A tiny electrode is employed to detect the activity of neurons in cortex. The transmitter is connected to the electrode and all the signals are transmitted to the receiver. The transmitter is powered with an AA battery, which can help the device to run continuously for approximately 48 hours.

The researchers have developed a neurosensory device which is compatible with the transmitter. The neuro sensor designed by the researchers is compact and light in weight. It consumes less power and transmits signals with high efficiency. Features such as small size, low-power consumption, and electrostatic discharge make the neuro electronic platform safer and very practical for the subjects moving continuously**.**

The NeuWalk project received funding from the European Union amounting to €9 million (approximately $10.66 million). The project was supported by École polytechnique fédérale de Lausanne (EPFL) Switzerland; Nurmikko's Laboratory,

Brown University USA; and Bordeaux Institute of Neuroscience, France. The researchers are currently working on using the nano sensor for clinical research on the human brain. The technology is expected to be commercialized in to two years' time. Once the technology is fully commercialized, it is expected to be well received by the neuroscience community. Blackrock Microsystems LLC of Utah has licensed a portion of the technology for further development.

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3. MULTI-SENSE CRACK-BASED SYSTEM

Although there are various electronic devices available in the market for speech recognition, these devices are not accurate enough to capture the exact words. There is a need for a flexible, sensitive, accurate, and durable device that can enable many applications with the same technological aspect. The flexible property of the device should enable wearable applications. The device should be sensitive enough to record and monitor even small variations in speech, heartbeat, or pulse rate. The device should also be able to monitor early environmental changes, such as earthquakes.

To address the above challenge, researchers from Seoul National University are developing flexible, highly sensitive, and durable sensors to monitor the heart rate, detecting, recognizing and recording speech patterns and music. The sensor system is called nanoscale crack junction-based sensory systems.

Researchers at Seoul National University are enabling mechanical sensors with the help of viscoelastic polymers. A 20-nanometer thick platinum layer is being integrated on top of the viscoelastic polymer. The platinum layer with cracks is deformed on the polymer, and these cracks create a gap, which leads to the soft polymer below the platinum layer**.** Opening and closing of the cracks can vary the resistance significantly. Small variations in the gap of cracks can alter the electrical resistance which can further be measured. With the help of these cracks, the researchers were able to measure the electrical conductance across the surface of the platinum layer. The cracked surface allows sound to be recorded and recognized clearly. This surface can capture the words accurately in an environment of 92 decibels. The researchers further employed the device on a violin and on the throat of a human being to measure and detect the change in sound. The polymer- based and cracked surface layer enables the device to be

flexible and durable. It can be used for wearable applications in healthcare or medical devices to measure the pulse rate or changes in heartbeat.

Once the project is successfully commercialized, it is expected to be employed in many applications, such as speech recognition, sound recording, and sensing the earliest tremors before an earthquake. In addition it can also be used in wearable electronic devices to monitor and measure blood pressure, and in some other medical applications, such as measuring pulse rates. Also, it can be used in autonomous cars to guide the sensor systems to open and close doors and narrate a route to commute.

The project was supported by the University of Vienna and the University of California, Riverside. The project is receiving funds from Seoul National University. The researchers have patented their design and are currently working on improving the design of the device. They are also identifying cheaper, durable, and more effective replacement of platinum. The researchers are also planning to do the long-term stability test. The project is expected to be commercialized in three to four years' time. Once the project is fully commercialized, it is expected to be useful for medical monitoring applications and earthquake detection.

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4. RECENT PATENTS IN THE FIELD OF INFRARED SENSORS

Infrared (IR) sensors are non-contact devices capable of emitting and/or receiving infrared light or IR radiation. Passive infrared sensors can be classified into two types--quantum or photon infrared sensors and thermal infrared sensors (which are less expensive, absorb IR radiation and undergo a change in temperature). Applications for thermal IR sensors include building automation/energy management, security and surveillance, transportation, consumer electronics, thermography or thermal imaging, presence detection (including gesture control).

Infrared sensing, moreover, is experiencing growth in various areas, such as the military and aerospace sectors for night vision and tracking, respectively. Infrared sensors find application in robotics for providing distance, direction, and object navigation. Additional applications encompass hyperspectral imaging, climatology,

meteorology, photobiomodulation, gas detectors, water analysis, petroleum exploration, rail safety, and so on.

A recent patent in infrared sensing powered by infrared absorbing and sensing parts (WO/2014/199583) is assigned to Panasonic Intellectual Property Management Co. Ltd., which provides an enhanced rate of absorption of infrared rays, thereby providing high sensitivity and reduction in heat capacity.

In total, 208,558 patents have been registered under infrared sensing. Out of these, 134,351 patents have been registered in the US, 13,929 patents in Canada, 1 each in Argentina and United Arab Emirates, 5 in Brazil, 6 in Singapore; 8432 in China; 3832 in Germany; 1587 in Russia; 12257 in Japan, 4524 in the Republic of Korea, 1131 in Israel and many more have been registered in different parts of the world.

Some major companies that have been involved in infrared sensing research include Intel Corporation, Nokia Corporation, LG Electronics Inc., Hewlett-Packard Development Company, L.P., Qualcomm Incorporated, Apple Inc., Microsoft Corporation, and Samsung Electronics Co. Ltd. Furthermore, there are also emerging startups, such as Pyreos, which offers passive infrared sensors capable of gesture control and proximity sensing.

Governments are also taking an initiative for supporting development of infrared sensing. The European Commission GEMINI (GErmanium MId-infrared plasmoNIcs for sensing) project aims to exploit a novel germanium-on-silicon platform to create an innovative optical sensing technology by introducing molecule-specific strong light-matter interaction at mid-infrared wavelengths through the engineering of plasmonic effects in group-IV semiconductors. The project coordinator is Politecnico Di Milano. Participants include Universitat Konstanz, Germany; Universita Degli Studi Di Roma La Sapienza, Italy; University Of Glasgow, UK.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
INFRARED SENSOR	18.12.2014; WO/2014/199583	PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.	KAKIMOTO, Katsumi	Provided is an infrared sensor having low manufacturing cost, having high sensitivity, or in which an increase in heat capacity is reduced. Provided is an infrared sensor provided with a first infrared absorbing part, an infrared sensing part for sensing infrared rays on the basis of infrared rays absorbed by the first infrared absorbing part, and a plurality of protruding parts comprising a metal and disposed apart from each other on a surface of the first infrared absorbing part. Since the rate of absorption of infrared rays is enhanced, high sensitivity is obtained, or an increase in heat capacity can be reduced.
INFRARED SENSOR AND INFRARED SENSOR DEVICE	17.12.2014; EP2813826	MITSUBISHI MATERIALS CORP	TARI KAZUYOSHI	Provided are an infrared sensor and an infrared sensor device that are less susceptible to effects from the casing and lead wires, can be surface-mounted, and can measure the temperature of the object to be measured in a more accurate manner. This invention has: an insulating film; a first and a second heat sensitive element provided on the insulating film; a first and a second wiring film that are respectively connected to the heat sensitive elements; an infrared reflecting film; a terminal support body, arranged on the one face; and a plurality of mounting terminals provided to the terminal support body, wherein the mounting terminals have support convex parts protruding upward, the support convex parts are connected to the corresponding first and second wiring films, and the insulating film is supported such that a gap is provided between the terminal support body and the insulating film.
FIELD-EFFECT-TRANSISTOR INFRARED SENSOR HAVING A MOVABLE GATE ELECTRODE	11.12.2014; WO/2014/195185	ROBERT BOSCH GMBH	FEYH, Ando	The invention relates to an infrared sensor (100) designed as a field-effect transistor, comprising a semiconductor substrate (117), which has a drain connection (110) and a source connection, wherein the drain connection (110) is separated from the source connection (115) by a channel region (105). The sensor (100) also comprises a gate unit (125), which can be moved in relation to the channel region (105) and which is arranged above the channel region, wherein the gate unit (125) is designed to change the shape of the gate unit and/or the distance (d) of at least one part (140) of the gate unit (125) from the channel region (105) in response to received electromagnetic radiation (135).

Light Sensors with Infrared Photocurrent Suppression	04.12.2014; US20140353792	Ju Donghyuk	Ju Donghyuk	A light sensor is formed by an array of photodiodes comprising plurality of a region of a first conductivity type that have been formed in a semiconductor layer or a substrate of a second conductivity type, and deep trenches placed between regions of the first conductivity type. Trenches extend deep into the substrate and have a high density of interface traps at the trench-silicon interface. A large portion of photocarriers generated by infrared recombines at the trench-silicon interface, and as a result, the spectral sensitivity of the light sensor is diminished in the infrared spectrum.
INFRARED COMMUNICATION SENSOR AND MOTION SENSOR NETWORK SYSTEM AND METHOD FOR LIGHTING IN GROUP UNITS BY USING SAME	04.12.2014; WO/2014/193184	JPK KOREA CO., LTD.	KIM, Seok Tae	A motion sensor network method for lighting in group units by using an infrared communication sensor according to the present invention comprises the steps of: sensing a first motion of a person or a vehicle by means of a first sensor module and turning on one lighting module; implementing infrared communication with another sensor module adjacent to the first sensor module and turning on another lighting module; maintaining the turning-on of the first lighting module and the other lighting module when the first sensor module or the other sensor module senses a second motion of the person or the vehicle; and turning off the first lighting module and the other lighting module when the first sensor module or the other sensor module fails to sense the second motion of the person or the vehicle for a certain time.
NEAR INFRARED OXYGEN CONCENTRATION SENSOR FOR PALPATION	27.11.2014; WO/2014/188906	NATIONAL UNIVERSITY CORPORATION HAMAMATSU UNIVERSITY SCHOOL OF MEDICINE	KANAYAMA Naohiro	Provided is an oxygen concentration sensor for palpation by which the contact of the sensor with a site to be measured is ensured so that the oxygen concentration (oxyhemoglobin concentration, deoxyhemoglobin concentration, degree of oxygen saturation, etc.) at the site can be surely measured, while minimizing effects on palpation performance. A near infrared oxygen concentration sensor (1) for palpation that is to be attached to the finger pad in the tip side of the first joint of a user's finger, said near infrared oxygen concentration sensor (1) comprising a base material (2) to be attached to the finger pad, a light-emitting means (4) which is formed on the base material and irradiates a target with light of at least two wavelengths including infrared light, light-receiving means (5a and 5b) which are formed on the base material and receive measurement light coming from a light-emitting device via the target, and a light-shielding means (3) which is positioned at least between the light-emitting means or the light-receiving means and the finger pad and prevents the measurement light coming via the user's finger to enter the light-receiving means, wherein the minimum distance between the light-emitting means and the light-receiving means is 3 mm or

				more and the maximum distance between the same is 15 mm or less.
Frequency selective infrared sensors	25.11.2014; US08897609	Sandia Corporation	Davids Paul	A frequency selective infrared (IR) photodetector having a predetermined frequency band. The exemplary frequency selective photodetector includes: a dielectric IR absorber having a first surface and a second surface substantially parallel to the first surface; an electrode electrically coupled to the first surface of the dielectric IR absorber; and a frequency selective surface plasmonic (FSSP) structure formed on the second surface of the dielectric IR absorber. The FSSP structure is designed to selectively transmit radiation in the predetermined frequency band that is incident on the FSSP structure substantially independent of the angle of incidence of the incident radiation on the FSSP structure.

Exhibit 1 lists some of the patents related to infrared sensors.

Picture Credit: Frost & Sullivan

Back to TOC