PHOTONICS NEWS

LASER COMPONENTS USA, Inc. Magazine #36 ▪ 07|16 laser-components.com

Editorial

Photonics versus Sports

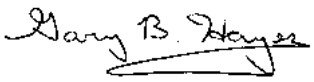
What is the role of optical components in sports?

We are all well aware about the myriad of applications in industry and research. However, many somewhat unusual applications - such as in sports - are out there waiting to be explored.

In light of upcoming international sporting events, we wanted to take a closer look at the latest optical analysis and measurement tools and how they enhance our athletes' performance level. The outcome of this research was very exciting. Optoelectronic is key to measure run-up velocity in pole vaulting, running speed and correct bicycle alignment. IR measurements contribute to breath gas analysis for the overall health of athletes and air quality in stadiums for spectators.

But this is not all. You have been loyal readers of our Photonics News and we have used the same format for many years. We have been working hard behind the scenes to provide you something new. It needed to be inspiring with new content, bringing it all together in a joyful magazine style.

Take a first look. We cannot wait to indulge you in this new and exciting world.



Gary B. Hayes
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Content

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Measuring Run-up Velocity in Pole Vaulting

Dr. Bettina Perlt, Institute for Applied Scientific Training, Leipzig

Pole vaulting is one of the most technically challenging disciplines in track and field. It is the only jumping discipline in which the result – in this case, the height cleared – can be influenced by the athlete even after the jump. ➔

Optoelectronic Measurement

Before the athlete can transition into vertical ascent, he/she must first carry out the horizontal approach with a pole in hand. First, the pole is carried raised up in front of the body, the tip is then lowered, and the bottom of the pole finally planted into the vault box. The athlete jumps up with his/her trail leg leaving the ground last, rolls him or herself up-right after achieving the C position with the pole, and crosses over the bar by stretching and subsequently turning his/her body.

The approach is one of the key elements. Reaching the fastest run-up velocity possible is a crucial prerequisite for achieving peak height in pole vaulting. More than 80% of the energy requirement is produced during the approach [4]. The goal is to provide the body's center of gravity with as much kinetic energy as possible at the beginning of the ascent, which is then converted to potential energy throughout the remaining part of the jump [5].

In the 1960s, the predecessor institute of the IAT carried out measurements to determine the run-up velocity in pole vaulting with the help of optoelectronic methods (light barriers). This method was used internationally in World Championships and the Olympic Games.
The positions of the double light barriers have remained the same since 1990: for men at 16 m, 11 m, and 6 m and for women at 15 m, 10 m, and 5 m before the back wall of the vault box. For boys and for decathlon 15.5 m, 10.5 m, and 5.5 m are valid.

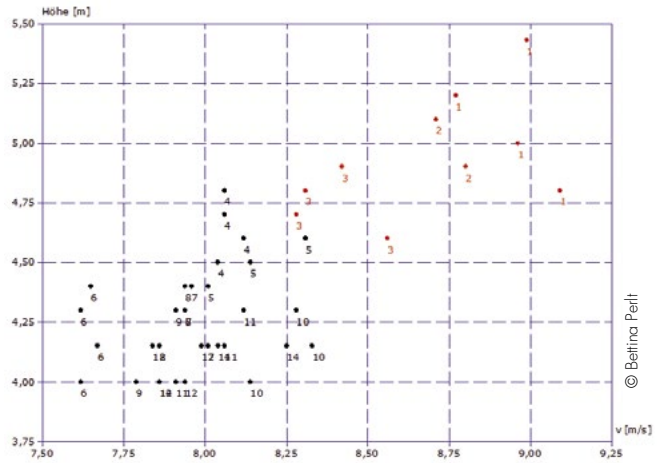

Fig. 1.: Height [m] depending on the run-up velocity [m/s] measured at a German Youth Championship. The numbers correspond to the placement achieved.

[1] Adamczewski, H., & Dickwach, H. (1991). Zum Zusammenhang zwischen Anlaufgeschwindigkeit und Sprungleistung. [The correlation between run-up velocity and the performance of jumping]. Lehre der Leichtathletik, 31(19), 15-18.
[2] Adamczewski, H., & Perlt, B. (1997). Anlaufzeitmessungen Stabhochsprung sowie Aspekte der Technik im Stabhochsprung der Frauen. [Measuring the pole vault approach and techniques of female pole vaulters]. Lehre der Leichtathletik, 36(31), 63-69.
[3] Adamczewski, H., & Perlt, B. (2007). Ergebnisse und Erfahrungen der prozessbegleitenden Messungen der Anlaufgeschwindigkeit im Stabhochsprung. [Statistical measurements and observations from the run-up velocity in pole vaulting]. Zeitschrift für Angewandte Trainingswissenschaft, 14(2), 7-23.
[4] Czingon, H. (2004). Sicher zum Einstichkasten. Leichtathletiktraining, [Safe into the vault box. Athletic training], 15(1+2), 26-29. Linthorne, N. P., & Weetman, A. H. G. (2012). Effects of run-up velocity on performance, kinematics, and energy exchanges in the pole vault. Journal of Sports Science and Medicine, 11(2), 245-254.
[5] Schade, F. (2012, März). Biomechanics of the Pole Vault. Paper presented at the 5. Kölner Symposium zum Stabhochsprung, Köln.

In 1993, IAT began recording run-up velocities using the LAVEG[1] from JENOPTIK GmbH. With the infrared laser, the distance of the athlete to the apparatus is recorded at a time interval of 0.02 s. Thus, 50 measurement values can be achieved per second. The athletes run up to a measured zero position (back wall of the vault box). Through interpolation the times are determined exactly for the positions, at which the light barriers are otherwise located. From this time difference, the average velocity can be calculated for each of these two measurement sections.

Measurements of the run-up velocity were carried out at IAT following the observation of several competitions. The statistical correlation between run-up velocity and height cleared has been repeatedly proven since 1966 [1] [2] [3]; Linthorne & Weetman, 2012. One could say that for every 1 m/s of higher run-up velocity, a half meter of height can be cleared per jump. And yet the velocity is only one of the performance-defining factors. Figure 1 shows the strong correlation between the take-off velocity and the height cleared at a German Youth Championship. You can see that the first-place pole vaulter is in the upper right-hand corner of the scatter diagram, which means that a higher run-up velocity was achieved. It shows that deviations are possible, which begs the question of whether the athlete who placed sixth cannot in general run any faster (i.e., insufficient running speed) or he can run fast but cannot transfer this advantage to the pole (insufficient arm strength and/or technique).

The LAVEG measurements provide additional information on the velocity curve (Fig. 2). ■

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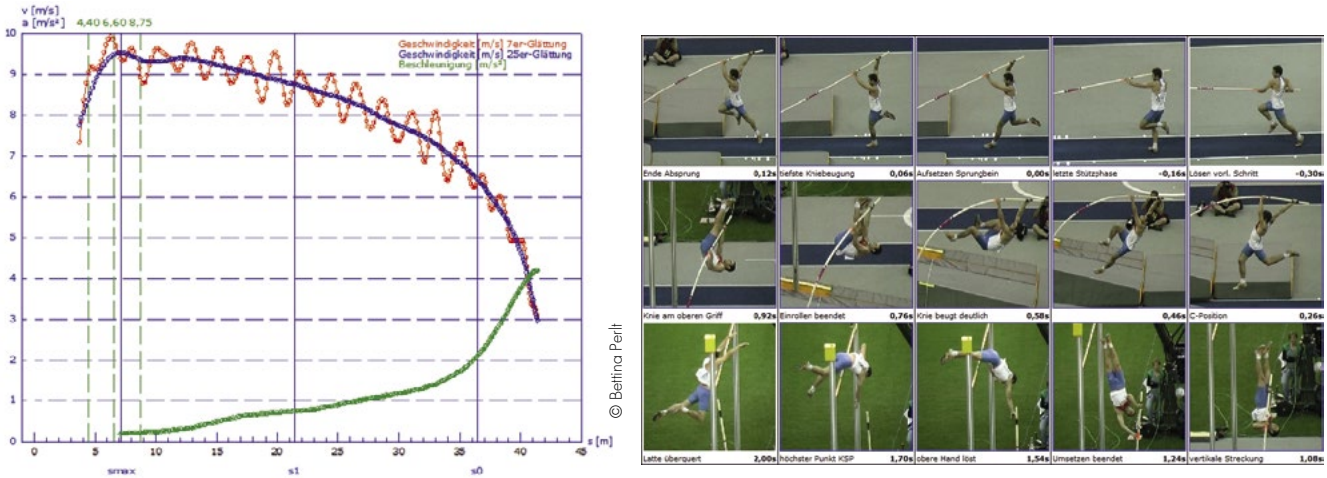
[1] Laser operated Velocity Guard



© Bettina Perlt

Fig. 2.: Velocity curves (blue and red) in two smoothing stages (Fourier smoothing). The acceleration (green) is derived from the more strongly smoothed speed. The perpendicular lines mark the grid points of the last two steps and the jump.

These Components are Used to Measure Speed

WEB US36-1041

The measurement of speed is used by both athletes and the automobile industry in particular.

Integrated into modern systems, the distance to the car ahead, for example, can be monitored, which significantly increases driving safety and comfort. This adaptive cruise control (ACC) is implemented using a light detection and ranging (LIDAR)-based sensor that calculates the position and speed of the car ahead via runtime measurements of the frequency shift.

The same technology is used by the police in speed traps that are carried out using a laser pistol.

The sensor consists of an emitter (pulsed laser diode (PLD)) and a receiver (avalanche photodiode (APD)).

To make the beam invisible to the human eye, the sender utilizes powerful 905 nm pulsed laser diodes (near infrared). With the 905 series, LASER COMPONENTS Canada produces diodes with a peak power of up to 650 W. For distance and speed measurements in sports applications, we have low-cost versions available with an output of a few tens of watts, which is completely sufficient. PLDs are used in combination with Si PIN or Si avalanche photodiodes. The Si APD of the SARF500Fx series is particularly advantageous here because the very sensitive APDs integrate a suitable 905 nm bandpass filter. This filter suppresses all scattered light and sunlight. Sports are definitely much more fun in day-light than rain or in a dark gym. ■

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Bike-Fitting with Lasers

Non-contact Body Scanning and High-precision Bicycle Measurement Using Laser Technology

Bicycling – A Healthy Activity

The positive effects of bike riding are well known. It promotes the concentration and perceptibility of children and teens, and it is movement that is gentle on the joints and increases endurance, performance, and general well-being. Thus, it helps prevent diseases and increases the metabolism [1]. As a popular sport, bike riding ideally helps maintain health. Of course, it is also a high-performance sport. In both cases, it is important to have "healthy" posture on your bike, even though the reasons for this vary. We are introducing excerpts from established measurement methods that serve this purpose.

Cycling – A Competitive Sport

Not only in Formula 1 racing are the driver performance and material optimized and coordinated to achieve maximum performance, but in cycling as well. Whether on a mountain bike, a racing bike, or in a time machine, an optimal sitting position guarantees maximum racing success. The bike is at the top of the list of things to be optimized. Manufacturers have their own R&D departments to construct bike frames that are as rigid as possible and to improve the aerodynamics in their own wind canals. Of course, professional athletes have their own training schedules. When athletes sit on their bikes, they train with pulse and power meters; the best performance can be achieved with watt-controlled training sessions. The best material and fitness are, however, not enough to win medals. An optimized sitting position is a deciding factor because an ergonomic sitting position guarantees optimal power transmission.

Fritz Buchstaller - Pioneer of Bike-Fitting in Germany

www.radsport-buchstaller.de

The pioneer of bike-fitting in Germany is located in the triathlon region of Roth. Fritz Buchstaller has been adjusting the sitting position of athletes for many years and is well aware of its importance in improving performance. The professional athletes, primarily triathletes, come from all over the world to profit from his know-how and to have their bicycles adjusted. Athletes should be able pedal in a manner that is as energy saving and stress free as possible. The optimal sitting position is often more effective than the increase in strength that can be achieved by a year's worth of training. The talk among athletes is of figures of up to 30 watts. By comparison: a hobby athlete can pedal between 200 and 300 watts. Thus, an optimized sitting position could increase performance by more than 10%!

WEB US36-0074

Line Lasers for Initial Adjustment

Fritz Buchstaller is one of just a few authorities in this area; he observes man and machine and uses his vast know-how to adjust the optimal position for each athlete. However, he also uses optical measurement technology to carry out adjustments. For initial bike adjustments, he uses a line laser to help analyze the leg axis during pedaling: the knee must operate upright to prevent long-term damage. A quick calculation: "Think about it: you cycle at 90 rpm, and your knee axis deviates 5 mm from the line. After just one minute, that deviation is equal to 45 cm. You can make your own projection as to how long you sit on your bike, and what effect that deviation has on your physique." Often, it is enough to make an adjustment in your shoe to correct the axis. Further adjustments are made to your bike until an optimum is achieved two hours later.

smartfit – A System Not Only for Top Athletes

www.smartfit.bike

Many athletes are aware of the importance of correct bicycle alignment; however, only a few have been able to properly adjust bicycles. Not only in high-performance sports does the position of the saddle, handle bars, etc. play a major role, but in the popular sport of biking as well. Incorrect positioning, even at the hobby level, can lead to knee or back problems and ultimately to a loss in interest in this sporting activity. That would be a shame because bike riding is one of the healthiest endurance sporting activities out there because the bicycle carries the body weight.

Laser-supported Measurement of Athletes and Material

Dr. Björn Stapelfeldt, who received his doctorate in sports science, developed the smartfit system with his bicycle laboratory team. With this system, it is possible to undergo a professional ergonometric consultation and receive an analysis of the sitting position, without being a biomechanics expert. This system is based on the laser-supported measurement of body and bicycle, which is carried out in a matter of minutes. A red cross-hair laser module is measured that is integrated in a calibrated rack system. At the push of a button, the individual measurement points are transmitted to the software. The database-based software is the heart of the measurement system and is where the actual expertise lies. It calculates the deviation from the actual position to the ideal position – depending on the desired wheel adjustment: from hobby cyclist to professional athlete. Depending on the scope of measurement, the height of the saddle and handlebars, the width of the handlebars, and the length of the handlebar stem and crank handle are determined. Dr. Björn Stapelfeldt's team carried out over 10,000 measurements prior to marketing the smartfit system: the recommended settings, which are exact to within a millimeter, are based on this test phase. For everyday biking, these settings are often sufficient.

After the static measurements are completed, ambitious athletes are equipped with a camera that is mounted to the side of their own bicycle to record their movement pattern. The recordings are used to determine the joint angle in order to adjust the final sitting position based on this angle – step by step. Specialized shops profit from this body scanning system, which steers the seller to a range of appropriate bicycles from over 30 manufacturers. If a bicycle has already been sold, a number of different service agents can carry out a bikefitting, which results in an optimal sitting position. In the U.S.A., the adjustment is practically standard; in Germany, it is slowly becoming more widely accepted, according to Stapelfeldt. In his bicycle laboratory, he advises professional cycling teams; he also has the mountain biker Helen Grobert under his wings. ■

[1]. Bicycle traffic in Germany: numbers – data – facts. Study of the Federal Ministry of Traffic Control and Digital Infrastructure, 2014.

© smartfit / radlabor

Laser Modules with a Cross-hair or Line Profile

The FLEXPOINT® cross-hair and line lasers are primarily used in industry to align and position objects. They are also used to position patients, for example to align them optimally for an MRT.

The measurement of athletes is a rather unusual application. Optimal results can be achieved with inexpensive modules. Classic cross-hair or line lasers are available with red light; however, green light is also available to achieve even better visibility.

This is especially the case when measurements are evaluated by the naked eye in daylight. ■

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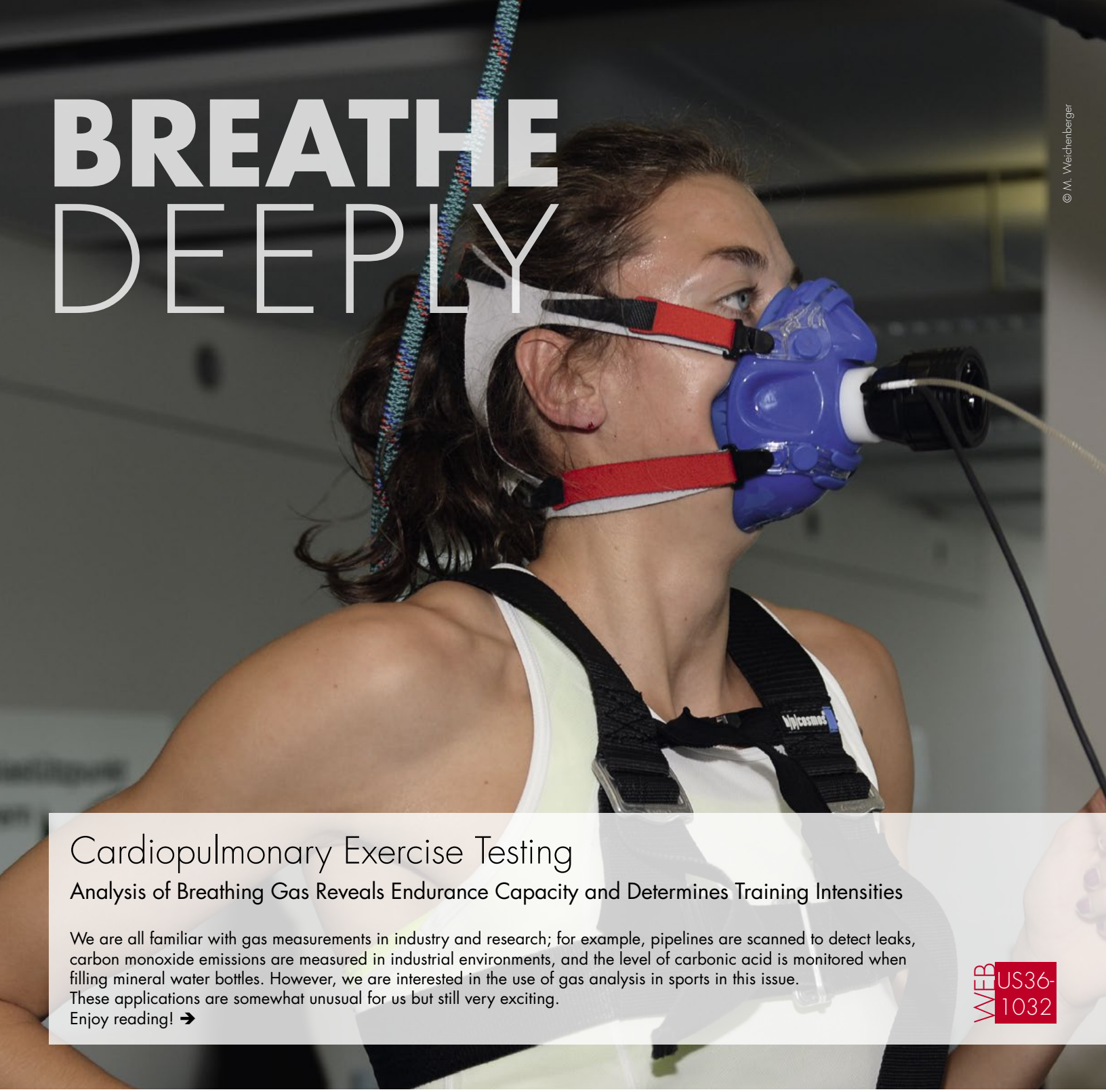
BREATHE DEEPLY



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Cardiopulmonary Exercise Testing

Analysis of Breathing Gas Reveals Endurance Capacity and Determines Training Intensities

We are all familiar with gas measurements in industry and research; for example, pipelines are scanned to detect leaks, carbon monoxide emissions are measured in industrial environments, and the level of carbonic acid is monitored when filling mineral water bottles. However, we are interested in the use of gas analysis in sports in this issue. These applications are somewhat unusual for us but still very exciting.
Enjoy reading! ➔

WEB US36-1032

Dr. Mario Weichenberger,
Preventive and Rehabilitative Sports Medicine, Technical University of Munich
www.sport.med.tum.de

Physical Activity, Energy Metabolism, and Oxygen Absorption

Movement during physical activity is only possible due to complex interaction between different skeletal muscles. The energy required for muscle contractions can be produced anaerobically (without oxygen) with a significant increase in lactate concentration in the blood or during oxygen consumption through the so-called aerobic burning of carbohydrates (glucose) or fats (fatty acids). With increasing intensity of physical activity (e.g., during endurance exercise), the energy demand of the muscle cell increases, which is covered by an increase in oxygen absorption. The more oxygen working muscles can absorb, the more energy can be supplied for muscle contractions and the greater the maximum endurance capacity is.

Factors Influencing Oxygen Absorption

The oxygen absorption of humans depends on the exchange of gas between the lungs and blood, the oxygen transportation capacity of the blood (hemoglobin), the distribution of blood in the body (circulation), and the oxygen absorption capacity of

muscle cells (mitochondria density and aerobic enzyme capacity). Endurance training improves all of these influential factors. For this reason, endurance athletes feature particularly high maximum oxygen absorption (VO_{2max} or VO_{2peak}).

Oxygen Absorption and Carbon Dioxide Release

Inhaled air and exhaled air differ in particular in their concentration of oxygen and carbon dioxide: While inhaled air is rich in oxygen (O_2) and contains little carbon dioxide (CO_2), the composition of exhaled air is exactly the opposite. The difference is due to the fact that the skeletal muscle consumes oxygen during physical activity and releases CO_2. Depending on the intensity of physical activity, the breakdown of glucose and fatty acids described above produces different amounts of CO_2. Based on the ratio of CO_2 release and O_2 absorption (respiratory exchange ratio), it is possible to analyze which form of energy supply dominates and how high the percentage of metabolized substrates is. This makes it possible to obtain the optimal training intensity or percentage of fat burning at different exercise intensities. The measurement of O_2 absorption and CO_2 release during physical exercise makes a differential analysis of the function and performance of the lungs, the circulatory system, and the exchange of gas in the body possible and is, therefore, of particular importance for both patients and athletes in performance diagnostics and optimization.

Cardiopulmonary Exercise Testing – Analysis of Oxygen Absorption during Exertion

Cardiopulmonary exercise testing is a diagnostic method in which respiratory gas analysis is carried out during increasing exertion, generally on a bicycle or treadmill ergometer (ergometry: from the Greek, ergon means work and metron means to measure). The physical exertion starts out very low and is continually increased for a timespan of approximately eight to twelve minutes to physical exhaustion. During the physical exertion, the test person wears a breathing mask over his/her mouth and nose and the concentration of oxygen and carbon dioxide in the inhaled and exhaled air, the breathing frequency, the tidal volume, the respiratory minute volume (breathing frequency x tidal volume), and the heart rate are continually analyzed.

Thanks to modern measurement technology, all measurement parameters are shown in real time, which makes it possible to carry out a detailed analysis during the physical exertion.

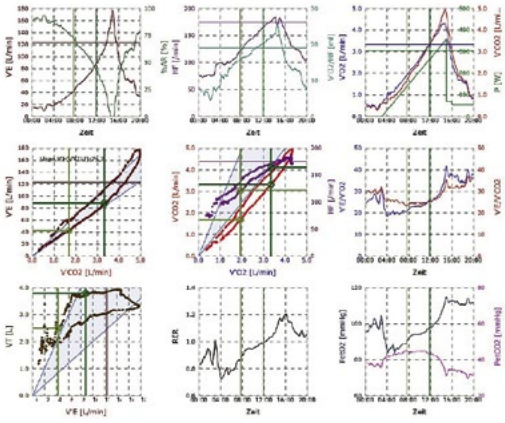

Fig.: 9-panel-plot according to K. Wasserman

Results of Cardiopulmonary Exercise Testing

The maximum oxygen absorption (VO_{2max}) achieved at the end of the endurance test is an important indicator in determining endurance capacity. The best endurance athletes achieve VO_{2max} values of up to 80 ml/min/kg, whereas non-athletes can absorb only approximately 45 ml/min/kg of oxygen. In addition, based on changes, for example, in the relationship between oxygen absorption (VO_2) and carbon dioxide release (VCO_2) or in the relationship between respiratory minute volume (V'E) and carbon dioxide release (VCO_2), so-called ventilatory thresholds can be determined. With the help of so-called 9-panel-plot according to K. Wasserman, the thresholds can be determined and other changes analyzed during the endurance test (see Fig.). The ventilatory thresholds can be used to determine optimal training intensity and are, therefore, of particular importance when managing endurance training for patients and athletes. Cardiopulmonary exercise testing is, therefore, particularly well-suited for both the differential analysis of performance and training management. For this reason, it is commonly used in sports medicine. ■

Components for the Measurement of Gases - Pyroelectric and PbSe Detectors are Leading Technology

WEB US36-0032

Whether used for breath gas or the surrounding air, gas measurements using NDIR are a classic application for IR detectors. LASER COMPONENTS manufactures detectors with various technologies: Pyroelectric detectors with integrated filters are very widespread. In order to measure gases very quickly or in a particularly small concentration, it is necessary for the detector to be particularly highly sensitive. Here, PbSe detectors are often used. They are also available immediately in a multichannel version. "The needle in a haystack" is found using laser measurement methods: xInGaAs, InAs, and DLaTGS detectors are used for this purpose. ■

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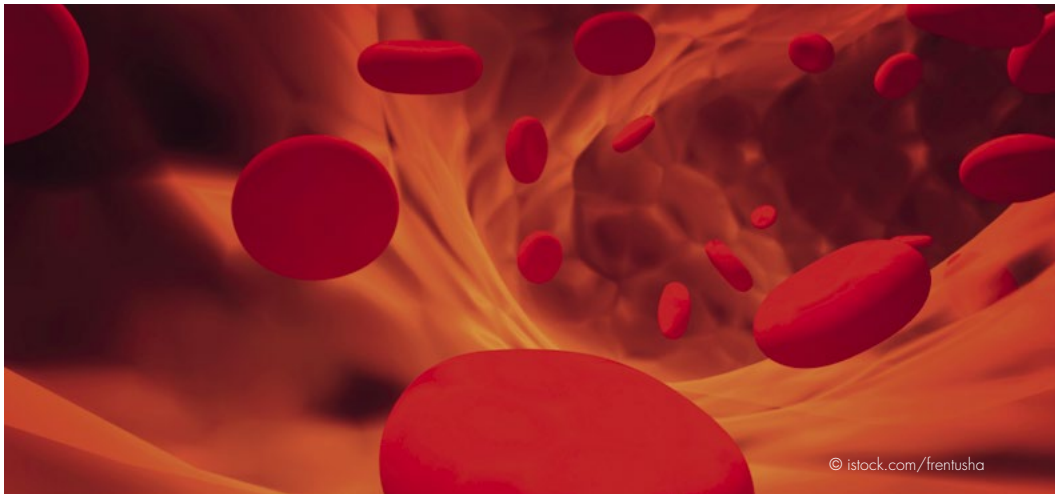
IR Spectroscopy Can Help

Respiratory Gas Analysis will be Used in the Future to Detect EPO Doping

Erythropoetin (EPO) is a hormone that promotes the development of red blood cells and is primarily produced in the kidneys. Hemoglobin is predominantly located in red blood cells; this red blood pigment binds and transports oxygen and is thus an important indication of endurance. The greater the total hemoglobin mass (tHb) is, the greater the maximum absorption capacity of oxygen VO_{2max}, and thus endurance, is. Endurance athletes, therefore, strive to achieve particularly high tHb values.



EPO Doping

Synthetically-produced EPO has made headlines as an illegal source of enhancing an athlete's performance. There are now many different ways to consume EPO. In addition to a large variety of preparations, doping can be carried out using one's own blood; this rich variety makes doping difficult to prove.

Today, detection methods are often based on the combined testing of urine and blood samples.

In urine samples, synthetic EPO can be detected within a restricted timeframe; however, some conditions must be met. For example, it is necessary that enzymes not be mixed in with the sample [1].

In a blood passport, an athlete's individual data is compared over time. As central measurement parameters, hemoglobin concentration [Hb], hematocrit (Hct), and the number of reticulocytes can be measured. Abnormal changes can be detected but a direct effect cannot. It is, therefore, necessary to include another parameter in the blood passport: tHb, which does not exhibit any significant changes at sea level, irrespective of one's training cycle. [2]

Method of Determining tHb

The goal of current research is to establish a practical, non-invasive testing method for determining tHb that neither strains the athlete nor takes a lot of time.

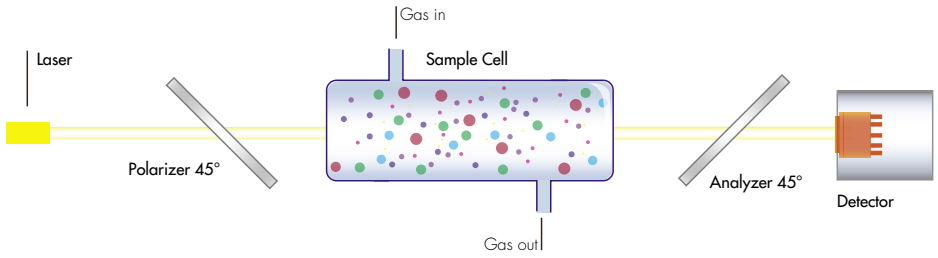
The most widespread measurement method for the determination of tHb is presently Schmidt and Prommer's CO-rebreathing method [3]. This is a breath test in which the athlete must initially inhale an amount of CO that is above a healthy threshold value: this method is too dangerous to serve as a standard, even though it is very accurate.

The company Invivo, Institute for Trace Gas Technology, has been working since 2009 with the World Anti-Doping Agency (WADA) on a method in which ^{15}NO is used as a tracer gas. A completed project has already shown that detection works on a principle level.

A follow-up project is currently running with the goal of optimizing this measurement method: a concentration of 20 ppm ^{15}NO should be inhaled for only 4–5 min.; a value of 40–50 min. was previously required. As a comparison: on a well-frequented street, the NO concentration is approximately 1.5 ppm; the threshold value recommended to avoid damage to one's health is 25 ppm.

Measurement Method

Technically speaking, this measurement method is a special infrared measurement: Breath gas labeled with ^{15}NO is tested via Faraday rotation spectroscopy, a special type of dispersion spectroscopy. [4] ■



[1] http://mobil.stern.de/gesundheit/hintergrund-epo-doping–nachweis-und-manipulation-3355706.html
[2] Prommer et al: http://www.medscape.com/viewarticle/584104; New methods based on IR gas analysis
[3] Schmidt, W. and Prommer, N.: The optimised CO rebreathing method: a new tool to determine total haemoglobin mass routinely. Eur J Appl Physiol 95 (2005) 486-495
[4] R. Gäbler, J. Lehmann. Sensitive and isotope-Selective (14NO/15NO) Online Detection of Nitric Oxide by Faraday-Laser Magnetic Resonance Spectroscopy. In: L. Packer, E. Cadenas. Methods in Enzymology, Vol 396, Nitric Oxide, Part E, pp. 54, San Diego, 2005

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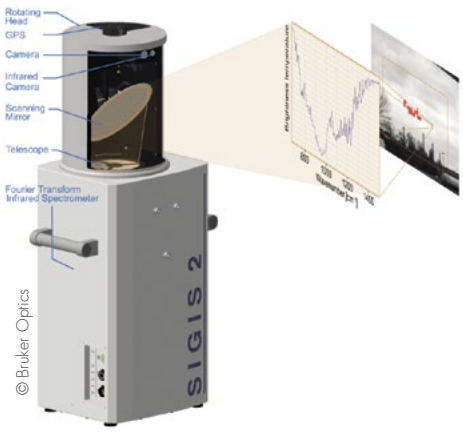
GOOD CLIMATE

Measuring the Air Quality in Stadiums

IR Measurement Technology is Used for Health Maintenance and Security Reasons

Air quality is a subject that is discussed extensively. It makes the headlines on a regular basis in connection with climate change, gas emissions, and the introduction of environmental zones. However, it is difficult to find contributions on air quality in connection with sporting events. In 2008, for example, measurements were carried out in the urban areas of Beijing in order to decrease air pollution during the Games: factories were closed temporarily and traffic reduced [1]. IR technology contributed to this effort.
Written by Joe Kunsch from LASER COMPONENTS.

Large events hold an enormous potential for the testing of new technologies, the collection of measurement data, and the further development of systems. For example, the *QCLOPS* free-beam quantum cascade laser system, which monitors ozone, ammonia, and carbon dioxide in the air, was tested in Beijing for the first time [1]. Open-path systems are suited for measurements over long distances. Further developments lead to a system of interconnected sensors that are used to predict air quality, especially in large cities and on industrial sites [2].



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Security Aspects of Large Events

Whether preparing for political summits or international sporting events, many aspects must be considered: these include testing the air for harmful gases. This is carried out via so-called *passive open-path FTIR*, which was originally developed for military applications (e.g., the localization and characterization of poisonous gas clouds). Passive systems are characterized by the fact that they do not require an external light source or reflection optics for these measurements. This allows for continuous 24/7 and 360° monitoring.

In Fourier transformation infrared (FTIR) spectrometers, a laser provides the frequency standard. In the beginning, HeNe lasers were primarily used for this purpose; however, they were phased out as part of the miniaturization process by single-mode vertical cavity surface-emitting lasers (SM-VCSELs). This led to the development of compact systems for use in civil applications as well: This allows fire departments to better assess large fires, hazard prevention teams to respond to possible poisonous gas attacks early on and send out warnings or evacuate.

One example of a "scanning infrared gas visualization system" is the SIGIS 2 from Bruker, which was christened at the start of the World Cup in Germany in 2006. Luckily, there have not been any serious incidents; however, this technology has still been tested many times: for example, at public viewing events in Stuttgart, it was possible to localize alcohol clouds [3]. These systems are used surprisingly often; in fact, even Brazil ordered units prior to the the Games. ■

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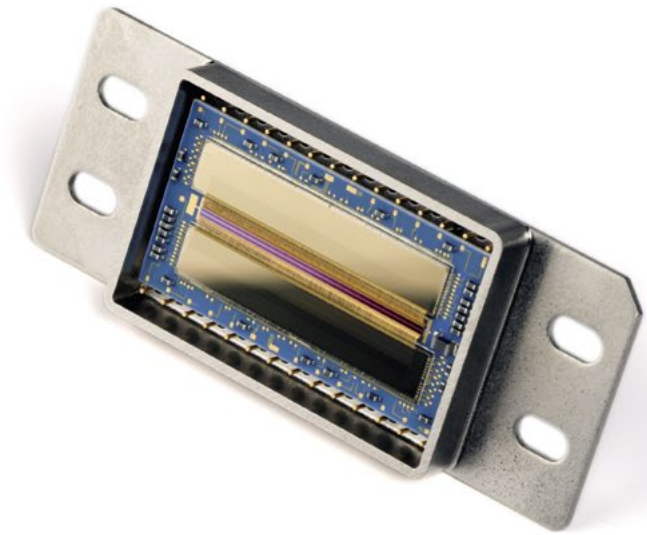
[1] Quantum cascade laser open-path system for remote sensing of trace gases in Beijing, China
http://www.daylightsolutions.com/assets/005/5447.pdf
[2] www.opensense.ethz.ch/trac
[3] Remote Sensing Systems monitor air in stadiums, Bruker, Application Note # 85



Understanding SWIR InGaAs Line-scan Detectors. For Imaging or Spectroscopy?

Laser Components Newest Partner Xenics Presents:

WEB US36-0091

The popularity of Short Wave Infrared (SWIR) line-scan technology increases for applications that require longer cutoff wavelengths than achievable with standard CCD or CMOS. This is mainly driven by cost optimization, quality control and reduced time to market.

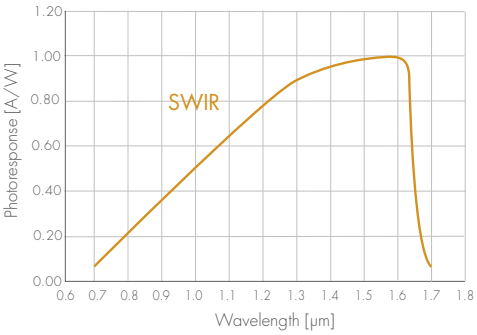
To give you an idea of what these SWIR line-scan applications can be, we listed a few:

- Sorting (waste, food, plastics, cotton…) based on characteristic absorption lines
- Spectral analysis of food quality (fat, starch, …)
- Optical Coherence Tomography (OCT) for medical and industrial applications
- Chip, wafer, solar cell, ingot and display inspection, … based on imaging through Silicon
- Glass bottle inspection based on thermal imaging using SWIR
- Quality control during paper production
- Moisture detection based on water absorption in the SWIR spectrum

Different imaging techniques are used based on the shape of the pixel. Pure imaging devices rely on square pixel imagers, equipped with band pass filters if needed. Rectangular pixel imagers are combined with spectrometers and used for spectral measurements. This is exactly the domain of expertise of Laser Components, so we will further focus on understanding infrared spectroscopy.

Infrared spectroscopy applications

Spectroscopy uses diffracted light to look at molecular vibrations bands (in the SWIR band, i.e., 800 to 1700 nm range for front-illuminated line-scan InGaAs arrays) in order to identify a specific material. Rectangular pixels are preferred for spectroscopy as they have a larger surface area and enhance the sensitivity. Typical applications are Raman spectroscopy (with laser excitation at 1064 nm), or spectrometers for optical performance monitoring in dense wavelength division multiplexing (DWDM) networks, where different wavelengths (around 1550 nm) are multiplexed in one optical fiber.



LASER COMPONENTS offers Xenics' product range of SWIR line-scan detectors with rectangular pixels called Xlin-R. The Xlin-R product line is available in three line resolutions of 512, 1024 or 2048 pixels, either uncooled or single-stage Peltier cooled, for increased temperature stability. The maximum line rate goes up to 40 kHz depending on the model.

Contact our IR array sales team to find out more about Xlin-R. ■

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30 Years of Optics Production

LASER COMPONENTS Celebrates Anniversary

WEB US36-0001

LASER COMPONENTS has been manufacturing laser optics in Germany for 30 years. We at LASER COMPONENTS are proud of the continuity that has ensured the quality of our products: Angelica Schaffel, a member of the optics production team, has been working at LASER COMPONENTS since 1989 and Rainer Franke, head of the laser optics sales group, will be celebrating 25 years of service at LASER COMPONENTS.

Although there are several production facilities on the market that manufacture laser optics from 193 nm to 10.6 µm, LASER COMPONENTS is particularly unique. Those who are looking for laser optics with particularly high damage thresholds have come to the right place. Additional special features include UV optics and laser optics for ultra-short-pulse lasers. ■

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New Products

New Standard Portfolio

Pyroelectric Detectors Made of $LiTaO_3$

WEB US36-0922

Trends, customer demands, production experience: We present to you the most popular pyroelectric detectors for industrial applications, now offered as part of our standard portfolio: The active material in these pyro detectors is $LiTaO_3$, and they are available for quick delivery.

The primary focus of this portfolio is, in particular, the easy-to-handle versions in current mode. Further advantages include consistent temperature curves and low power consumption. The recommended supply voltage is +3 V. These versions are recommended for new developments.

Dual detectors in classic voltage operation are also part of the core portfolio; they are already being used successfully as a second source product.

The selection of bandpass filters is quite large: With over 17 variations, our customers have access to new applications.

Our standard portfolio consists of the following:

- L1100X2020 & L2100X2020
  Single-channel detector,
  Current mode,
  With or without temperature fluctuation compensation (TFC)
- L1200X1810 & L2200X1810
  Dual-channel detector,
  Current mode,
  With or without TFC
- L4200X1810
  Dual-channel detector,
  Voltage operation,
  With TFC

Both single-channel detectors with BaF_2 windows and our mount-on filter set are generally available in stock: in this combination, we offer excellent flexibility for preliminary tests. ■

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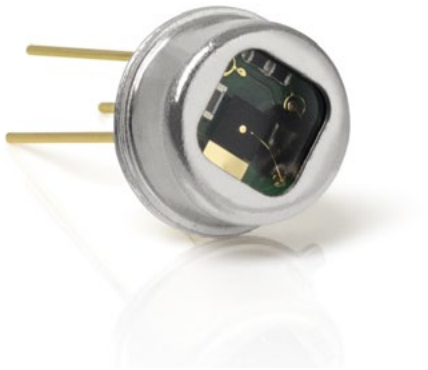
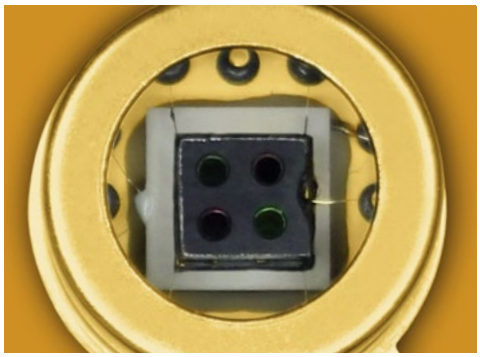


PbSe Detectors Now Also Available with Four Channels

The PbSe Alternative to Pyroelectric Detectors Offers a Higher Detectivity

WEB US36-9231

The lead selenide detectors are also available in a quad version with four channels: an attractive alternative for gas measurement.



When applying PbSe detectors, it was previously necessary to use either several single detectors or filter wheels to detect different wavelengths. Our solution saves you space in your system, time when measuring, and costs in procurement.

Four selected PbSe chips are arranged in quadrants and equipped with their own filter. The readout of all channels is carried out simultaneously. For an improved signal in the long-wave range, we also offer cooled versions.

Advantages
With these new detectors, you can measure and analyze gas mixtures simultaneously – this is fast. In addition, you save space: instead of four single detectors or a filter wheel, you can simply use a TO-8 or TO-39 housing.

Pyro or PbSe?
Quad detectors have been available with pyroelectric detectors for years; they are generally used for gas analysis. In some applications, a higher D* value or higher speed is desired – both of which are offered by lead salt detectors. The same filters are used for pyroelectric detectors and PB detectors. As a manufacturer of both versions, you can not only rely on our neutral advice regarding different technologies, but you also have a particularly large selection of gas filters available. We also offer the assembly of your own filters. ■

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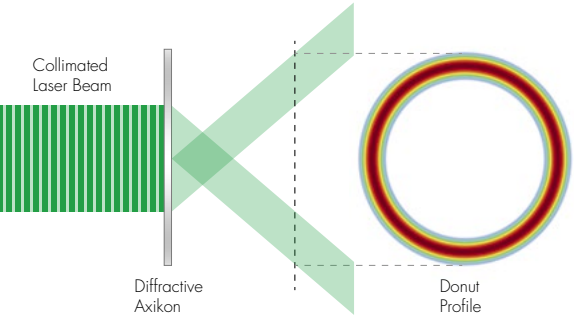
Axikon DOE - Shape Your Laser Beam into a Ring Profile

Suitable for all Transversal Modes with Beam Quality M^2 <20

WEB US36-0949

Laser beams with a ring-shaped profile are required in ophthalmology, laser welding, and the material ablation of thin films.



In order to produce this ring profile, often classic axicons are used: conical lenses and rotationally-symmetrical prisms. These elements convert a laser beam with a Gaussian profile into a Bessel beam. Axicons are very difficult to produce for very large or very small fan angles because in these cases the cones must either have a very shallow or very steep angle respectively; thus, an optimal ring profile generally cannot be achieved.

Holo/OR now manufactures diffractive optics with an axicon structure. These DOEs yield vastly superior results to the classic axicon. The ring profile remains close to perfect, irrespective of the fan angle, as the optic uses grating technology.

The versatile diffractive axicons are suitable for almost all lasers providing the M2<20, and are available on both fused silica and ZnSe.

Furthermore, the element's performance is independent of the input beam mode. There are more than fifteen standard designs available with a peak-to-peak ring angle of 0.05° to 30°, with the option of custom designs upon request.

Do you wish to know how these DOEs differ from vortex DOEs and which element is better suited for you? Then give us a call! ■

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New Filters for Pyroelectric Detectors

Now Available with NDIR Devices: Selectively Measure Water Vapor and Methane in Gas Mixtures

WEB US36-1922

To keep it short: Pyroelectric detectors are used in gas analysis. Each gas can be detected using a very specific wavelength – the so-called absorption wavelength.

Moisture is often tested with the wavelengths 1.94 µm and 2.9 µm; however, in this case, the absorption wavelengths of CO2 overlap the signal: with these wavelengths, the moisture of the gas mixtures can only be determined using complex measurement equipment.

However, with simple NDIR measurement devices, it is possible to achieve a reliable measurement: here, you only require the right filter and a suitable light source.

The central wavelengths of our new filters are selected in such a way as to significantly reduce the crosstalk to other gases to achieve uncomplicated measurements with NDIR measurement devices.

These three new filters are available for our pyro detectors:

- For the measurement of methane (CH_4): λ_{CWL} = 7.91 µm ± 160 nm
- For the measurement of alcohol mixtures: λ_{CWL} = 9.50 µm ± 450 nm
- For the measurement of moisture (water vapor): λ_{CWL} = 5.78 µm ± 180 nm

An overview of all filters and filter curves can be found under the webcode provided! ■

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Lumics "LuOcean™ Mini 4" Now Available with OEM Driver Board

Lumics GmbH, Berlin is Proud to Present its Brand-new, In-house Developed OEM Driver Board

WEB US36-0091

This driver board expands Lumics' portfolio of class leading products enabling customers to work with complete state-of-the-art solutions for a wide range of different medical, analytical and industrial applications.

This proprietary driver board was developed with intent to provide an optimal digital interface to all functions of the diode laser modules from the Lumics' LuOcean™ series. It is optimized to give all critical information and control over the diode and over the integrated sensors and features.

The associated diode laser module – the brand new LuOcean™ Mini 4 - is now offered with power levels up to 70W in an ultra-compact design.

It is available with up to three different, independently controllable wavelengths in only one laser head. Available wavelength ranges are continuously being expanded, ranging currently from 760 nm up to 1940 nm. Special customized wavelengths and features can be offered on request according to customer specific requirements. ■

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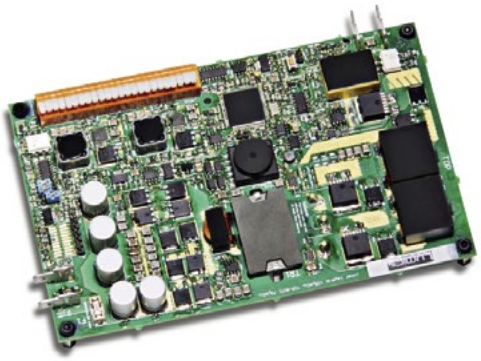

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PRODUCT

FiberKey P – The fiber coupler for CO_2 lasers, which transmits laser light and a pilot beam

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