PHOTONICS NEWS

LASER COMPONENTS USA, Inc. Magazine #40 ▪ 03|18 laser-components.com

High-Tech Food Packaging with Diffractive Optics

The Use of Light in Food Processing is Manifold

IR Technology Helps in Winemaking

New Products

UPCOMING EVENTS

The Vision Show
Boston, MA
April 10–12, 2018
Booth 410

SPIE DCS
Orlando, FL
April 17–19, 2018
Booth 1029

Sensors Expo
San Jose, CA
June 27–28, 2018
Booth 225

Content

Technologies in the Food Industry

Industry News

Product News

LASER COMPONENTS®

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What's for Dinner? Spotlight on Food.

We all know that without sunlight, grapes, other fruit, and vegetables would not grow. Plants convert energy from light into sugar through photosynthesis to grow, form flowers, and develop fruit. What we don't always realize is how light plays a crucial role in the food and beverage industry before it makes it to our dinner table.

Early in the food chain process, artificial light is being used more often to stimulate plant growth indoors. Appropriate types of lights are High Intensity Discharge (HID) lamps, Light Emitting Diodes (LEDs), and fluorescent lights; each using different ranges of the spectrum, luminous intensity, and color temperature.

Once food is ready for processing, other elements come into play. For example, in optical sorting, cameras in combination with LED illumination help capture information like color, shape, dimension, and labeling. Also, lasers and near infrared light are used to determine the chemical composition of materials to distinguish one from another. When converting fresh produce into processed food, UV light or pulsed (UV or white) light are effectively used for sanitizing, cleaning, and preserving food. It deactivates microorganisms like bacteria and fungus.

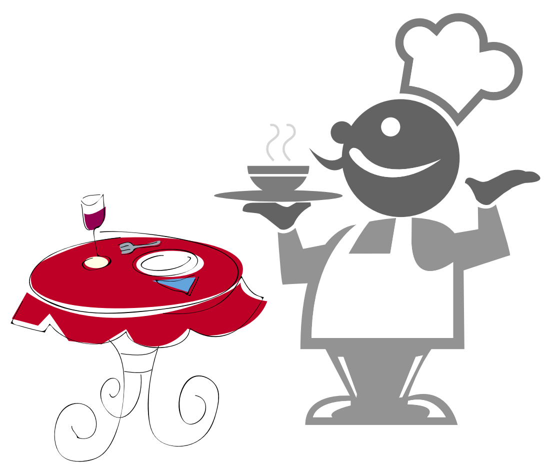
Driven by a growing population, urbanization, changes in lifestyle, and awareness for sustainable agriculture and farming, we are shifting toward better nutrition and quality of food. Additionally, strict regulations and producing at lower costs have made the food industry seek out alternatives to safeguard food and increase yield. In this edition of our Photonics News we would like to shed some light on how photonics is associated with wine production, how light can protect us from germs, and what lasers make possible in the food packaging industry.

Bon Appétit!

Sincerely,

Gary B. Hayes

Gary Hayes
CEO/General Manager, LASER COMPONENTS USA, Inc.



IN VINO VERITAS

Looking Forward to the 2017 Wine

Worldwide, the U.S. ranks fourth for total wine production. California represents this statistic almost completely. The region produces 7% of the world's wine. Only Spain (third), France (second), and Italy (first) produce more [1].

Reviewing the 2017 wine grape harvest in California, wine makers report on reduced yield but promise strong quality wine across all varieties. Environmental factors, including rainfall totals ending a five-year draught, a late-summer heat wave, and wildfires in October, all will have an impact on the final result. Takeaways from the Wine Institute's report on the 2017 region-by-region harvest analysis [2] are whites showing bright, fresh flavors and reds that are intense and rich. ➔

[1] World Wine Production by Country (2015). Retrieved from: http://www.wineinstitute.org/files/World_Wine_Production_by_Country_2015.pdf
[2] California Wine 2017 Harvest Report (November 8, 2017). Retrieved from: http://international.discovercaliforniawines.com/wp-content/files_mf/californiawineharvestreport2017_final.pdf

Good Wine – Not Just a Matter of Taste

IR technology can be used to find out valuable information about a wine

In a product with a thousand-year-old tradition, it is not surprising that wine production depends very heavily on the experience and gut feeling of the winemaker. It is only recently that science has found its way into this field. Meanwhile, almost all biochemical processes have been identified that are used to make wine from the juice of grapes. Because vinification is a complex process, the quality of wine depends on many different factors. IR measurement methods are, therefore, very useful to vintners during production.

The Grapes Make the Wine

During vintage, it is crucial that the harvested grapes be processed as quickly as possible. In a mill they are mashed together with the seeds and skin. In the production of white wine, this mash then stands for one to six hours before being processed into must. During this time, the first substances already take shape that then later affect the quality and taste of the wine.

Analyzing Mash with the Help of Spectroscopy

For a long time, spectroscopic measurements in the mid-infrared range have provided press operators with a comprehensive analysis of the mash and its contents. This provides the press operator with the ability to not only identify undesired microorganisms but to draw conclusions about the properties of the most.

Analyzing Grapes with the Help of NIR Spectroscopy

Scientists at the State Educational and Research Institute for Viticulture and Pomology in Weinsberg have developed a method in which the quality of individual grapes can be tested before mashing.

To date, the grapes provided have always undergone visual quality control and been sorted accordingly; however, even experienced professionals can make mistakes because many microorganisms that settle on the fruits in the vineyard are not visible to the human eye.

Although the presence of yeasts can be quite desirable, some can lead to early fermentation, which can complicate vinification.

With the help of near-infrared spectroscopy – a new method in this field – important contents are measured while the grapes are filled into the mill. Based on the concentration of glucose, fructose, tartaric acid, and malic acid, the degree of maturity can be determined, for example. Acetic acid, gluconic acid, glycerin, and the ergosterol produced by mold show, however, that the degradation process has already started. Based on this data, the cellar master can adjust the further vinification process to suit the quality of the grapes.

A Long Fermentation Process Will Eventually Produce Wine

After mashing, white wine is pressed: the pomace (i.e., the solid components such as the skin and the seeds) is separated from the liquid must, which then ferments and ultimately turns to wine.

This is the crucial difference between the production of white wine and red wine: Because the red color and many of the flavors come from the skins and seeds, the mash is fermented in red wine. It is not placed in the winepress until after fermentation is complete.

To achieve an optimal ethanol yield and prevent impurities, as little air as possible should enter the container during fermentation. At the same time, however, the carbon dioxide produced must escape; otherwise, the fermentation container would burst. This is achieved with special fermentation vats. Nevertheless, winemakers prefer to keep an eye on the development of the wine in this critical phase of vinification. IR technology helps in this respect.

X-InGaAs Line Array for Measuring Carbon Dioxide

WEB US40-092

If you would like to measure the CO_2 concentration in a champagne bottle, a single measurement point does not suffice. It is better to have 256 pixels in a row from the start, such as in the extended InGaAs arrays from LASER COMPONENTS. The IG22 series covers a spectral range of up to 2.1 µm; and the IG26 series arrays can even be used at wavelengths of up to 2.5 µm. These sensor arrays have complex requirements for which we offer the electronic OEM control module TEESS. ■

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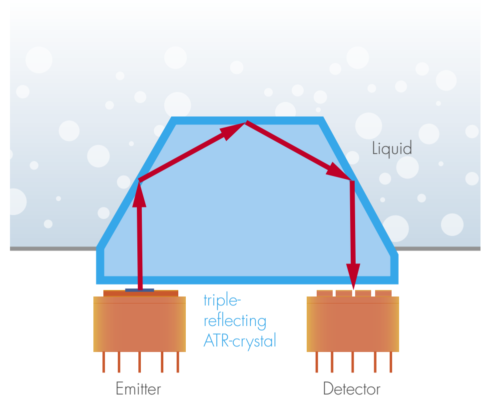
FTIR Spectroscopy during Fermentation

Classic FTIR spectroscopy is ideally suited for this purpose. In devices such as the OenoFoss by Foss, a single drop of must or wine is sufficient to analyze up to seven different parameters. This allows the winemaker, for example, to determine within a matter of minutes how far advanced the fermentation process is. The measurement results allow him the ability to draw conclusions about the finished wine and perhaps change something. These devices make it possible to make very precise measurements.

In-Situ Measurement

Another method originates from the U.S. manufacturer VitalSensors. They work according to the principle of the attenuated total reflection (ATR) of MIR beams at the interface between crystal and liquid. The measurement system with a triple reflecting ATR crystal is applied directly to the fermentation tank or the pipes (see figure). These in-situ measurements have the advantage that they do not allow air to come into contact with the fermenting must, and the cellar master can still obtain all of the important information on the temperature and concentration of the four important contents at any time. It is does not matter whether the tanks contain a clear (white wine) or opaque (red wine) liquid.

This helps to convert the grapes into the best possible wine using infrared technology.



If It Bubbles

Sparkling and semi-sparkling wines can be produced using different methods. The best-known method is the "champagne method," in which the finished wine is fermented one more time in the bottle by adding yeast and sugar. It is crucial in the end product that the carbon dioxide produce negative pressure. This leads to the refreshing tingling sensation that champagne and prosecco drinkers love. At a positive pressure of 3 bars at room temperature, the wine is referred to as sparkling; at a positive pressure of 1 to 2.5 bars, the wine is referred to as semi-sparkling.

How do you tell how much carbon dioxide is in a closed bottle? IR technology can also be used here. An Austrian manufacturer has developed a device that measures the CO2 concentration without having to open the seal. A laser beam is guided through the upper part of the bottle and analyzed using a detector. The best part is that the bottle can still be used after that.

This measurement method not only works in champagne and Cava but in comparably "primitive" drinks such as cola or other soft drinks. ■

Pleasant Atmosphere

In State-of-the-Art, High-Tech Packaging Food Stays Fresh Longer

Fruits and vegetables are the alpha and omega of the health-conscious person of today. However, vegetables from the farmers' market are present in fewer and fewer kitchens. Cooking and "gardening" are more like hobbies in our hectic times than daily tasks required for subsistence. Shopping should also be quick and easy. The supermarket has long since replaced the corner store because it is much more convenient to buy everything you need in one spot. It is still required that goods and produce be fresh and crisp.

Air Is a Thing of the Past

Meats, fish, fruits, vegetables, milk products, and bread – really fresh food only stays fresh a few days maximum. After that, they begin to spoil, mercilessly. How do supermarkets manage to keep the shelves stocked every day with fresh goods that look so inviting and seem to call out to us "Buy me!"?

The secret is in the packaging.

In so-called ***modified atmosphere packaging*** (MAP), the packaging is filled with a gas or gas mixture instead of air. Most commonly, nitrogen and carbon dioxide are used. Oxygen is undesired in these cases because it is not only the main cause of the oxidation-related spoiling of food but it also promotes the growth of aerobic microorganisms.

The composition of a substitution atmosphere depends on the contents of the packaging. For example, the percentage of CO_2 for beef is 20%, for fish is 80%, and for pasta products is 60%. Products packaged with MAP stay fresh significantly longer – often twice as long as when stored in fresh air. They can sit on the shelves longer and do not have to be disposed of within a few days.

Protective atmospheres are not only used in comparably small supermarket portions, controlled atmospheres are also used to prevent, for example, the early ripening of bananas upon transport from Colombia to Europe. In other foods, such as milk products, manufacturers can often completely forego the use of preservatives thanks to MAP.

Sometimes holes are desired.

One special challenge is packaging for fresh fruits and vegetables. After harvest, these products are still living organisms in which biochemical processes take place: the fruits "breathe" (respiration) and "sweat" (transpiration). To ensure that they stay fresh in their packaging, a small amount of oxygen must have continuous access and the CO_2 produced during respiration must be able to escape.

This can be achieved via laser perforation. Microholes are burned into the packaging in a targeted manner that suits the respiratory activity of the product and regulates the oxygen content accordingly. Depending on the food and material, these holes can range in diameter between 50 µm and 300 µm.

Lasers ensure that at these small sizes a uniform perforation results that meets all of the requirements of the packaging industry.

Pulsed CO_2 Lasers for Microholes

To ensure that the beam penetrates all of the layers of the packaging, CO_2 lasers with high pulse intensities are most commonly used. To achieve an even distribution of the holes at exactly defined intervals, diffractive optical elements (DOEs) are used. A 15 x 15 multispot element can produce 225 partial beams from one laser beam; these partial beams burn 225 holes into a film with one shot. The size of and distance between the holes can also be changed with the help of an additional optic.

... and how do I access my food?

To maintain the protective atmosphere in the packaging, everything must be right. The majority of packaging films are so-called multilayer structures and, therefore, consist of several stacked layers.

Each material has its own function: PET, for example, is responsible for stiffness and aroma conservation; flexible but tear-resistant PE serves as a sealing medium; PP is impermeable to water vapor; and aluminum protects light-sensitive food.

Robust packaging is one thing, but the consumer does, after all, want to be able to open the package easily and without a big fight. Lasers help here, too; however, they are not used as light swords but as tools in the manufacturing of packaging.

Manufacturing Tear Strips with Lasers

The trick to so-called tear strips is to weaken the mechanical layers of the composite plastics in a targeted manner while maintaining other functions such as aroma conservation and light protection. This is possible via laser scribing.

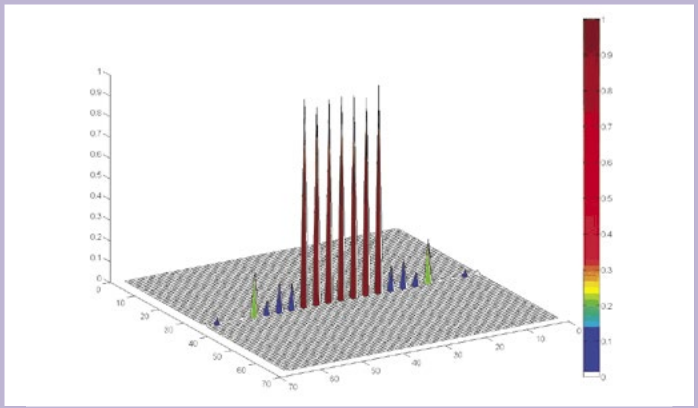
Because the components of the composite material have different optical properties, individual layers can be processed with the laser while other layers remain intact. Computer-controlled scribing systems are most commonly used to achieve the complex designs in the material. Industrial image processing systems make correct positioning on the packaging possible. With a corresponding software program, the beam can then be controlled as necessary for each individual package.

Integrated Pressure Cooker

Laser perforation keeps food not only fresh but also makes it possible to quickly and easily prepare ready-to-eat meals. Vegetables, meat, and fish are placed together with the packaging into the microwave and cooked. The package remains closed the entire time and not even water must be added. Similar to a pressure cooker, the container builds up pressure to quickly and gently cook the contents. The trick is a valve that is integrated into the protective foil and that opens if a certain amount of inner pressure builds up to allow the steam to escape. ■

In Excellent Shape with Diffractive Optical Elements

Diffractive optical elements (DOEs) are substrates into which microstructures are etched using a lithographic process. The diffraction effects allow laser beams to be split, bundled, or formed into almost any shape. Thus, the application possibilities of DOEs are quite versatile. Unlike classic beam-shaping processes, DOEs have the advantage that the desired structures can be provided with a single optical element and the beam energy almost completely utilized.
Our partner Holo/OR manufactures DOEs for application in high-power lasers. ■



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WEB US40-949

Automation in the Food Industry

Sorting, Analyzing, Processing – Optoelectronic Methods Are Almost Standard Today

"The good ones go on the dish, the bad ones put out if you wish." Even in fairy tales, food such as peas and lentils had to be separated from undesired foreign substances. This fundamental principle has remained the same, even today. However, whereas in the story world it was possible to call on a host of busy little birds, in the real world we rely on state-of-the-art optical technology today.

Industrial image processing with food?

When we talk about "industrial image processing," we often picture robots in huge factory buildings. We seldom think of apples, potatoes, and rice. However, the production of food has little in common with romantic images of agriculture. The same technologies are meanwhile used in farming as those in industrial manufacturing.

Quality Control

One of the most important fields of application of optical technologies is quality control. In facilities in which tons of fruits, vegetables, meat, and fish are processed daily, it is unthinkable to carry out quality control by hand. At the same time, the quality requirements are constantly being intensified by lawmakers on a regular basis and consumers are becoming more and more demanding. It no longer comes down to just the objective criteria of quality for consumers: it is becoming increasingly important that food also look good. Podgy strawberries or carrots with two "legs" are considered by many unenjoyable, even if they do not have any defective spots.

The rise in such demands often leads to the increase in the ingenuity of engineers. We can meanwhile observe a suitable sorting facility for each criterion.

Optical Sorting Machines

Depending on what a machine is designed to sort, different sensors are used (i.e., most commonly laser systems and diverse types of cameras).

Simple cameras provide images of the size, shape, and color of fruits. They are always used when it is important to control the outer appearance of fruits.

Bad spots on apples and potatoes usually have a different color than the healthy parts. Thus, monochromatic cameras can be used to sort the good from the bad because they are sufficient for distinguishing the contrast between light and dark.

Polychromatic cameras are used to separate food from each other when color variations play a role (e.g., to separate red, yellow, and green gummy bears).

Surface Analysis using Laser Light

Unlike pure camera detection, combining laser modules and cameras makes it possible to analyze the surface structures of objects.

At certain wavelengths, they can penetrate deeper into the tissue of food, thus providing insight that would not normally be visible during purely external controls. These properties are used in sorting facilities to sort out stones, glass, and metal, for example. The "defective" elements can also have the same color as the "good" elements. Normally, potatoes and stones would be otherwise difficult to distinguish based on their outer appearance, but they have completely different surface structures.

IR Spectroscopy

Another area of application is IR spectroscopy. It is used, for example, to determine the exact amounts of fat, protein, and other nutrients in meat. This makes it possible to correctly indicate these nutritional values on the packaging, which is required by lawmakers.

Sorting Process

Foreign substances and damaged food recognized by the optical systems are sorted using different methods. Today, small objects like the peas and lentils in the story of Cinderella by the Brothers Grimm would be catapulted from the ashes and collected in containers using compressed air nozzles. Larger fruits like apples and potatoes are often mechanically redirected to land in the appropriate boxes depending on size and grade of quality.

From grains of rice to fish filets, there is nothing today that cannot be analyzed, cleaned, sorted, and processed by machines with custom optical methods.

Therefore, only food that meets all quality requirements makes it into the supermarket. ■

When Plants Glow Red

Sorting machines use a unique feature of chlorophyll to differentiate green fruits and vegetables from other green objects: If the tissue is exposed to UV light, the plant parts appear to glow red.

The reason for this is chlorophyll. This pigment is crucial to the metabolism of plants. Under "normal" conditions, it absorbs blue and red wavelengths and uses their energy for photosynthesis. The green light is reflected. This is why grass and trees appear green. Long-wave UV radiation exposure, however, results in chlorophyll fluorescence: Part of the pigment, so-called chlorophyll a, converts a part of the incoming UV radiation and emits it in the form of heat. The rest is emitted as light in the visible spectrum – in this case at a wavelength of approx. 670 nm. This is the reason that the corresponding plant parts do not appear green but red. In objects without chlorophyll, however, this effect does not occur. The objects can, therefore, be clearly defined as not plant based and sorted out.

Bit by Bit

A Question of Weight

WEB US40-074

More and more food lands pre-portioned on the supermarket shelves. But how can you be sure that all portions have the same weight? Laser technology can also be used to answer this question. With the help of laser modules, the shape of the objects can be measured three dimensionally – no matter how crooked or misshapen they are. Based on this data and the average weight of the goods, a computer can calculate where the cuts have to be made for each section to have the same weight. ■

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IR WORKshop a Success

Niche Event Surfacing

WEB US40-IR

After having three successful bi-annual IR WORKshops previously held at the LASER COMPONENTS Corporate Headquarters in Olching, Germany, the idea was developed to launch a U.S. version in the alternating years. As a result, we organized the 4th International WORKshop on Infrared Technologies November 8–9, 2017 in Tempe Arizona – home of Arizona's largest public state university (ASU).

One of the keynote speakers Aidan Brooks, from LIGO Labs CalTech and team member of the 2017 Nobel Prize winning group in Physics, opened the event speaking about the requirements of the third generation gravitatonal wave detectors. The agenda covered a vast majority of topics including: IR Detectors and new materials development, Mid-IR spectroscopy and sensing, Quantum Cascade Lasers, and commercial applications.

Gail Overton, Senior Editor from Laser Focus World, has dedicated a featured article highlighting the advances in Infrared Photodetectors, a topic that was covered at the WORKshop. IR detectors, from shortwave to (very) longwave, are improving in performance; whether this is related to new compound semiconductors or because they operate in cryogenic, room-temperature, or high operating temperature (HOT) conditions. We invite everyone to read the detailed overview: https://goo.gl/ah2P75

To round off the two-day event, five participating students have been honored for their outstanding work in STEM (Science, Technology, Engineering, and Math). The IR WORKshop offered them the perfect platform to share their experience, talk to industry leaders, and potentially look for job opportunities.

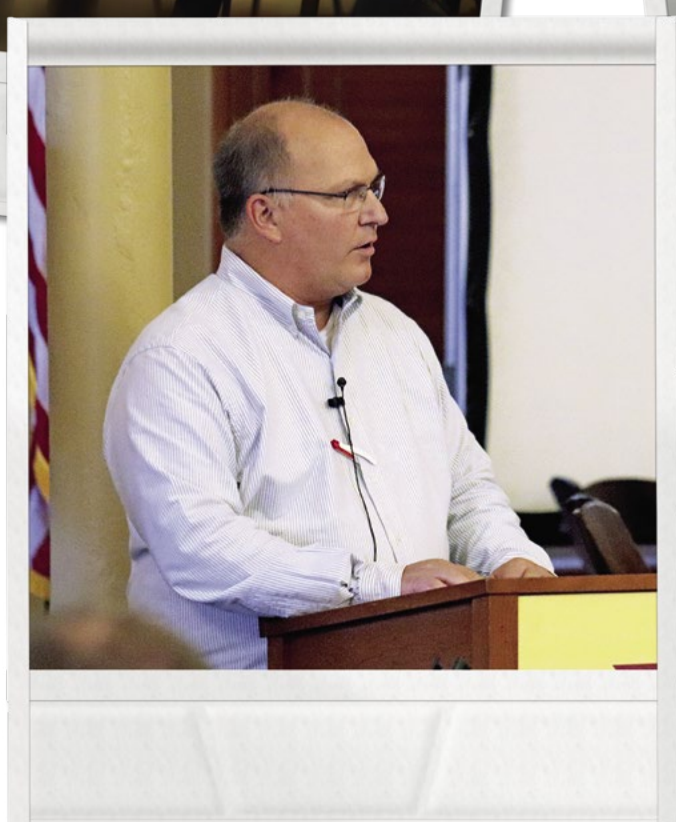
IR WORKshop ir-workshop.info

The well-balanced program of theory and applications attracted about 80 engineers, general managers, industry professionals, and students. A well-respected Advisory Board, MIRTHE+ Photonics Sensing Center at Princeton University, and the Center for Photonics Innovation at Arizona State University greatly contributed to this success. ■

A future event in 2019 in the U.S. is already guaranteed.

Those interested in participating at the 5th International WORKshop in Olching, Germany, can find more information on:

www.ir-workshop.info



New Products

Superior Thermoelectric Coolers for PbSe/PbS Detectors

Leveraging Mid-IR Detection

WEB US40-923

Enhanced PbSe/PbS detector performance can be achieved by both cooling and temperature stabilization. The latest available Thermoelectric Coolers (TECs) provide that control with greater efficiency at lower operating power levels. Cooling PbSe/PbS detectors increases sensitivity and extends the peak wavelength response. These improved heat pumps achieve the same ΔT with less required cooler power.

Better feedback control of the TEC top stage maintains detector temperature stability. Combined with proper heat sink design and identifying the optimum operating temperature, these superior TECs help to provide the best possible detection in the mid-IR. ■

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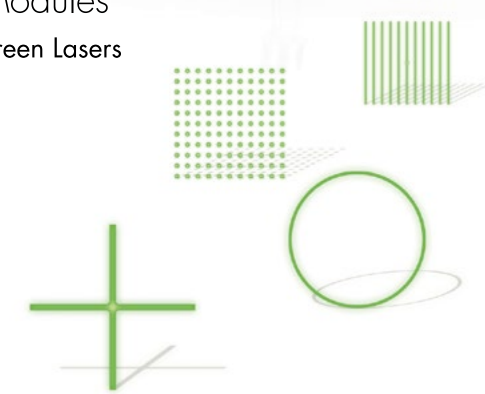
Expansion of DOEs for Laser Modules

New Pattern Generators Available for Green Lasers

WEB US40-075



Diffractive Optical Elements (DOEs) are ideally optimized for a specific wavelength.

Because the green 520 nm wavelength is becoming more and more popular, we have expanded our product range with a number of new DOEs for green light, including a cross hair that has a fan angle of more than 50°, and a DOE with 15 parallel lines. ■

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Collimated Homogenizer Modules

Diffractive Optical Elements for High Power Lasers

WEB US40-949

The Collimated Homogenizer Module is Holo/Or's customer-specific solution for applications requiring a wide range of working distances. With a Collimated Homogenizer Module, the uniform-intensity beam is maintained with high reliability, power uniformity, and constant size/shape over an extended working distance range up to 300 mm.

Popular applications include aesthetic skin treatments, laser welding of polymers, and laser surface treatments such as cleaning, hardening, de-coating, color ablation, … ■

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QuickSwitch Pulsed Laser Diodes

Hybrid PLDs with the Shortest Pulse Duration for Precise Measurements at Short Distances

WEB US40-950

The following applies to distance measurement: The shorter the laser pulse, the more accurate the measurement.
LASER COMPONENTS Canada has developed a hybrid pulsed laser diode with the currently shortest pulse duration in the world. In one second, the QuickSwitch PLD generates up to 200,000 laser pulses with a typical duration of 2.5 ns. Depending on the operating voltage, it achieves an optical peak power of up to 89 watts.

The laser chip and switching electronics are integrated in a compact TO-56 housing. The hybrid design enables the shortest bond wires: a current path with low inductance can be achieved which is necessary for pulse lengths of less than 3 ns.

An additional ground pin that is independent of the signal and supply return, turns the entire housing into an effective Faraday cage that protects the QuickSwitch PLD and its environment against electromagnetic interference. ■

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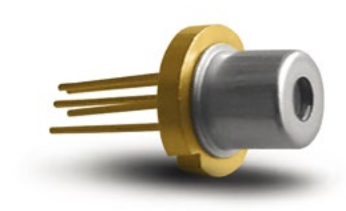


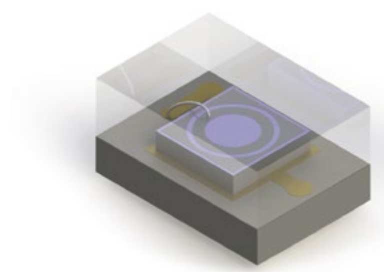
Low-Cost Avalanche Photodiodes in an SMD Package

APDs Used in Rangefinding Applications Even Smaller Than Before

WEB US40-953

The SAH series avalanche photodiodes have been optimized for the wavelengths 850 nm and 905 nm. They are also available, effective immediately, in an M1 package: at dimensions of just 2 mm x 1.4 mm, the M1 package is the smallest of our SMD housings.

This inexpensive component is specially designed for distance measurements in which, due to lack of space, larger detectors cannot be installed. Consumer products are commonly fitted with this version.



Depending on the version, the diameter of the detector area is 230 µm or 500 µm. Similar to the components in the M2 and M2F package, the noise is lower and the response time particularly high. The SAH series APDs can be operated at temperatures between -40 °C and +85 °C. ■

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Linear APD Arrays – Optimally Suited for Time-of-Flight Measurements

New Standard Versions Simplify the Introduction to Scanner Development

WEB US40-952

In addition to the linear Si APD arrays with twelve elements, the LASER COMPONENTS Detector Group has now also included arrays with eight and sixteen elements in its standard range.

The LCC44 housing of these new models makes it possible, on the one hand, to mount the components as SMDs on circuit boards. On the other hand, it offers enough space for the integrated multi-channel amplifier circuit. For operation, only one voltage is required for the array, whereas 5 V are required for the electronics.

The components are based on fast, low-noise avalanche diodes arranged in a monolithic array. Our arrays are characterized by a very narrow gap between the elements. This gap is just 40 µm. Furthermore, they have a very low temperature coefficient. Their sensitivity is optimized for the NIR range between 800 nm and 900 nm.

Upon request, we also build linear arrays according to your specifications. You determine the number and size of the individual elements; they can be arranged along one or two axes. ■

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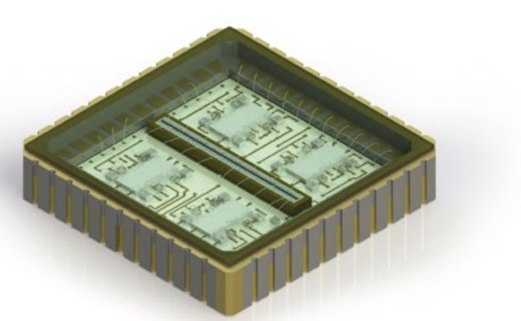

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