How SWIR Technology With Sputter-Coated Interference Filters Helps Determine Food Quality

Sputter-Coated Interference Filters Help SWIR Machine Vision Systems Advance Automation for the Food Industry

For the food and beverage industry, shortwave infrared (SWIR) imaging is being adopted for food and food packaging applications to detect discrepancies. The following introduces how the technology works and the role lighting and filters play in advancing the benefits of this machine vision solution.

How SWIR Works

SWIR imaging uses low-frequency light that allows it to see many objects much differently than a visible camera would. For example, SWIR cameras can see through plastic and various liquid materials, which gives SWIR machine vision systems a major advantage over VIS-NIR systems to detect food quality.

Implementing quality optical filters with SWIR technology improves contrast for better reliability in machine vision applications. Filters have a bandpass that determines which wavelengths it will let through and which it will block. While traditional color filters offer a single bandwidth, and a less effective passband shape, sputter-coated filters can capture images over single or multiple bandwidths without suffering losses in contrast or resolution. Even in environments with high-frequency or bright light sources, sputter-coated filters work with various vision systems, including SWIR, resulting in improved contrast.

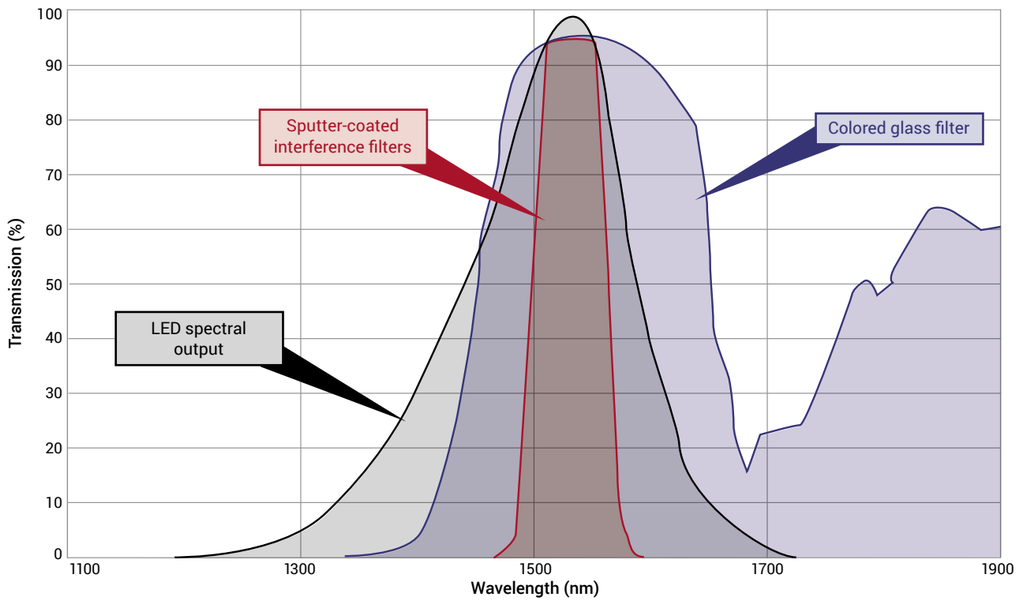

Fig. 1. Sputter-coated filters provide the best combination of brightness and contrast for machine vision.

LED Advances Accelerate Machine Vision

As LED technology has improved in cost, efficiency, and output intensity, LED lighting has replaced traditional lighting sources. Small, integrated LED arrays are lasting longer, providing more intense light and even shorter strobe on/off cycles. Traditional lights such as incandescent or halogen bulbs take more time to reach full intensity and turn off, while LEDs can complete this cycle orders of magnitude faster. The ability to cycle on and off quickly at great intensities has created light arrays capable of strobing more than 100,000 times a second with 10 times the output of some traditional lighting solutions.

Demand is growing for machine vision systems that can operate accurately and repeatedly at high speeds in settings such as food and beverage plants, reducing lead times and increasing the rate of production. Additionally, machine vision systems are evolving to incorporate more complex tasks into their capabilities. Automating food inspection and sorting tasks can be costly because it's difficult to capture the data necessary to maintain quality without disrupting production speeds. Fortunately, LED and filter technologies have advanced while reducing the barrier of entry and making machine vision solutions such as SWIR more accessible.

Better-Tasting Food With Filters and SWIR Technology

Other SWIR applications include meat inspection. Integrators in the food industry are using SWIR LEDs and grayscale InGaAs cameras outfitted with sputter-coated filters to determine the age, grade, damage, disease, and bone location in meat. In addition to ensuring food is safe, this technology produces data that, when combined with basic arithmetic, can produce an image accentuating bone and various tissues in high contrast.

The USDA and other organizations use grading systems to rank the quality of marbling in meat. Marbling — or the ratio of fat and muscle in meat — is associated with the flavor and quality of the product. Accurately capturing marbling data can ensure cost-effective, unbiased food grading and inspection. An automated vision system's ability to inspect, grade, and detect specific features in any type of meat ensures that product is properly USDA graded. Additionally, this level of food inspection gives companies the ability to charge premium rates for high-end cuts.

Fig. 2. A bruise on a piece of fruit will show up on a SWIR image as a black mass due to its water content.

Courtesy of Smart Vision Lights

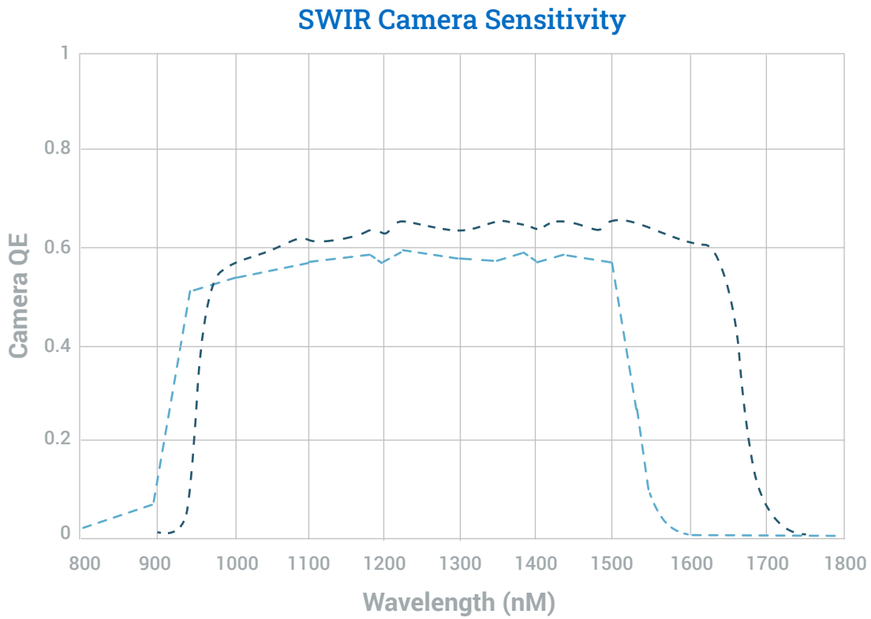

Fig. 3. A typical InGaAs SWIR camera offers the sensitivity to accurately capture food data.

Attenuating Unwanted Light

Traditional filters have a Gaussian bandpass shape. The lazy slope of a color filter allows more unwanted light, or noise, into an image. With vision applications evolving and being asked to do more complex tasks at higher speeds, it is imperative to reduce as much unwanted light as possible. Sputter-coated filters have a square bandpass shape that can hone the range of what wavelengths it lets through the system. In an ideal machine vision environment, no other light sources would be present other than what is needed to detect desired objects and features. Ambient light, windows, and even lasers can interfere with imaging systems. While an environment free of unwanted light is not realistic, sputter-coated filters such as Chroma's ContrastMax attenuate up to 95% of unwanted light largely due to their square bandpass shape.

Additionally, sputter-coated filters from leading manufacturers can use a single lighting source and camera to capture single or multiple bandwidths without compromising image resolution or contrast. With advanced lighting in machine vision, SWIR and sputter-coated filters can simultaneously inspect products for damaged packaging, bruises, and other characteristics while providing the information necessary to guide automation equipment for inventory or sorting processes.

Furthermore, food and beverage companies can rely on the capability and accuracy of SWIR machine vision with sputter-coated filters to improve machine vision systems already in place, delaying or even eliminating the need for expensive upgrades. If a new vision system is needed, the existing sputter-coated filters and advanced lighting can compensate for less advanced and more cost-effective cameras and lenses. Companies meet quality and production goals while reducing cost and improving ROI.

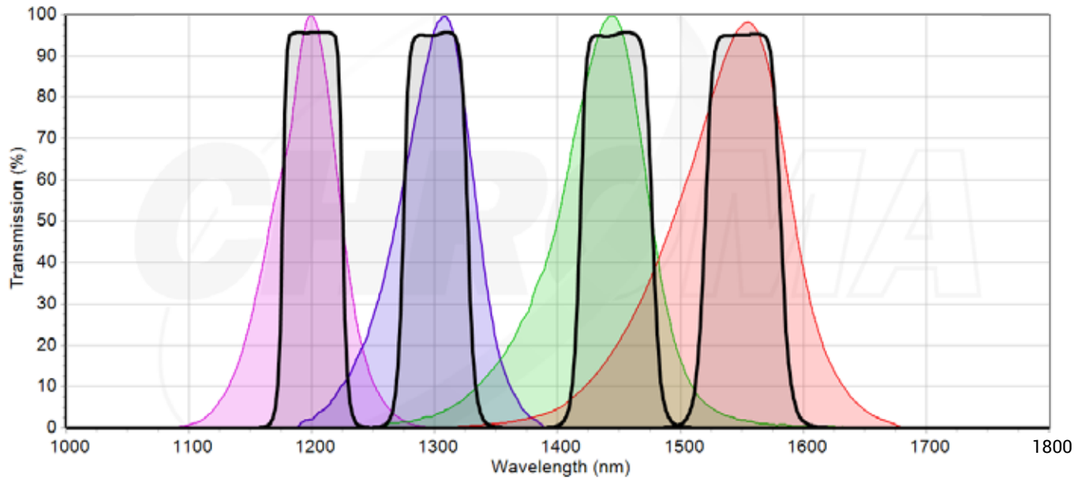

Fig. 4. Sputter-coated filters have a square bandpass shape that can hone the range of what wavelengths it lets through the system. The ContrastMax filter passbands shown are centered on the peak wavelengths of common LEDs.

Automating the Food Industry's Future

With Chroma's manufacturing capabilities, it is possible to design tolerances into sputter-coated filters for single or multiple bandwidths to increase machine vision accuracy and reliability and reduce false reads. Despite the ability of sputter-coated filters to accept and block single or multiple bandwidths accurately, it is still important that machine vision systems do not completely rely on outside lighting sources. Machine vision applications should have a dedicated lighting system to ensure an imaging system's capabilities are not diminished. With SWIR, Chroma sputter-coated filters, and the right lighting, machine vision systems can drive quality inspections and automation controls at the same time from a single light source and camera.

Constraints in the food industry are driving trends in automation and vision to increase production and reduce cost while maintaining or improving quality. As the population grows, producing quality food effectively and quickly is an increasing concern. Technologies such as machine vision improve automation and accelerate manufacturing production. Machine vision increases food safety and profits through inspections and detecting features such as prime cuts of meat quickly without disrupting the flow of production. SWIR machine vision systems and sputter-coated filters expand the capabilities of the food industry while ensuring the safety and quality of the food on your table and beyond.

For more information about sputter-coated filters for SWIR machine vision systems, please **contact us** today.

US Corporate Headquarters
10 Imtec Lane
Bellows Falls, Vermont 05101 US
info@chroma.com
Tel: +1-800-824-7662
+1-802-428-2500

Chroma Technology GmbH
Maximilianstrasse 33
D-82140 Olching, Germany
europe@chroma.com
Tel: +49-8142-2847525

Chroma Technology Japan
8F Yokohama Onoecho Building
4-57 Onoecho Naka-ku
Yokohama 231-0015 Japan
Phone: +81 (0) 45 285 1583
Fax: +81 (0) 45 285 1501
japan@chroma.com

Chroma China
Rm 803, Building No.16
Yuanbo Wuli
Xingjin Road, Jimei District
Xiamen City, Fujian Province 361021
Phone: +86-0592-5062089
china@cn.chroma.com

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