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PUTTING SENSORS TO WORK

Ultraviolet fluorescence sensors can solve many assembly and inspection problems simply and inexpensively.

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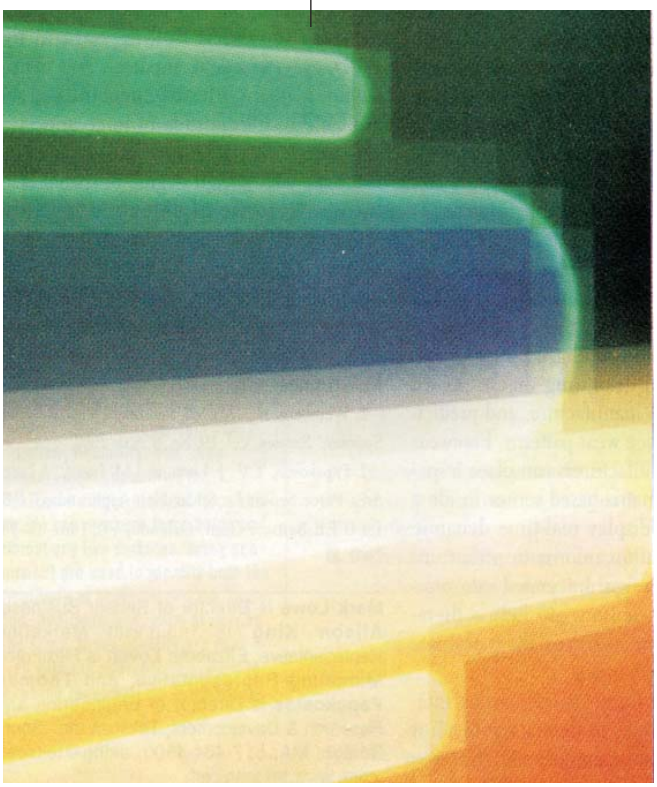
Don't Overlook UV Sensing

Industrial assembly and inspection operations benefit from several light-based sensing technologies. Noncontact photoelectric sensors detect product presence/absence at distances from millimeters to meters. Color sensors are essential to ensuring uniformity of appearance. And machine vision systems, at the high end of the price/performance scale, carry out tasks ranging from determining the product's orientation on the assembly line to verifying the correct placement of labels.



There's yet another type of light-based detector, the UV fluorescence (sometimes called luminescence) sensor, that works by detecting materials that fluoresce naturally or fluorescent marks applied to an object. The fluorescent substance may be invisible to the eye. Exposed to light at the UV end of the spectrum, however, atoms or molecules in the substance become excited and emit light of a characteristic frequency. The UV light source is pulsed, and the sensor is tuned to the same pattern of flashes so that it ignores most other signals. Fluorescent emission ceases abruptly when the UV source is between flashes. The technology is inexpensive and low end, but can handle a surprising variety of jobs.

Applications

UV fluorescence sensors are used extensively in QC programs. One good example is the manufacture of connecting rods for automobile and truck engines (see Figure 1). The rods are machined with the caps in place, then separated for installation in the engine. Since the caps must be reinstalled in the same orientation in which they were machined, they are marked before disassembly with a water-soluble UV-enhanced ink. The visible mark guides the assembler to put the caps on correctly, and a UV fluorescence sensor down the line verifies that the assembly is correct.

UV crayons are widely used in the lumber industry for grading purposes, and there are automatic sorting and cutting machines that use UV sensors. Other common applications of the technology include:

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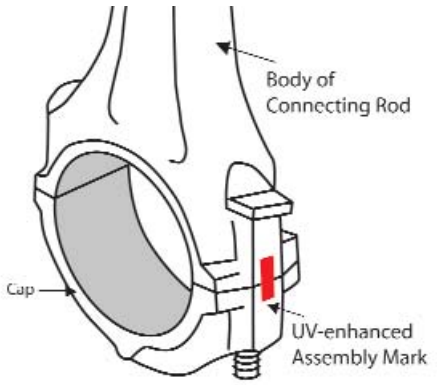

Figure 1. An assembly mark in UV-enhanced ink guides workers in installing connecting rod caps correctly, and can be read down the line by a UV fluorescence sensor for QC purposes.

• Furniture making. Detecting the presence of excess glue in a joint of wood furniture.

• Automotive. Inspecting a muffler pipe for the presence of a copper fitting; detecting the presence of a UV-curable gasket.

• Adhesive tape. Measuring the amount of adhesive sprayed on a roll of tape; when a nozzle gets clogged, the sensor provides feedback leading to an alarm condition.

• Lumber. Inspecting for the proper coating of a clear fungicide.

• Food packaging. On ring-tab cans, detecting a transparent seal that prevents the seam from rusting; detecting the presence of straws attached to juice box containers when the orientation of the straw is too variable for a vision system.

• Pharmaceutical. Detecting the presence of a plastic tamper-proof seal on a bottle.

• Clothing. Detecting the presence of a fluorescent thread that verifies that a seam has been sewn.

• Packaging. Detecting the presence of glue on cartons; detecting the presence of surgical staple cartridges.

• Electronic assembly. Detecting the presence of tape on wiring harnesses.

• General industrial. Detecting the presence of paint on a product.

Where Will It Work?

Some materials are naturally fluorescent. Starches, for example, glow bright blue under UV; many natural greases glow, too, as well as some adhesives and some paints. It's possible to detect the presence or absence of any of these with little or no modification.

Some engineers don't consider UV sensors because they don't think of their targets as having UV properties, but almost anything can be made UV responsive. For things that do not fluoresce naturally, it's

Figure 2.

Selected Suppliers of UV Fluorescent Materials

Company	URL	Location	Products
Amark	www.amark-flm.com	Gresham, OR	Fluorescent lumber markers, wax, pigment
Amantech	www.amantech.com	Raleigh, NC	Fluorescent pigments, dyes
American Coding & Marking Ink Co.	www.americancoding.com	Plainfield, NJ	Fluorescent inks
Associated Chemists, Inc.	www.achemists.com	Orangeburg, SC; Portland, OR	Lumber-marking inks, dyes, stains
Beaver Luminescers Div. of Beaver Cloth Cutting Machines	www.luminescers.com	Newton, MA	Luminescent pigments, inks
Carco, Inc.	www.carcousa.com	Detroit, MI	Fluorescent inks
Cleveland Pigment & Color Co.	www.clevelandpigment.com	Cleveland, OH	Fluorescent pigments
Day-Glo Color Corp.	www.dayglo.com	Cleveland, OH	Fluorescent inks, pigments
Dixon Ticonderoga	www.dixonusa.com	Heathrow, FL	Fluorescent chalk, crayons
Foxfire-RDT	www.foxfire-rdt.com	Richmond, BC, Canada	Fluorescent lumber markers
Functional Materials, Inc.	www.functionalmaterials.com	Sloatsburg, NY	Fluorescent pigments
Honeywell Lumilux	www.lumiluxpigments.com	Seelze, Germany	Lumilux fluorescent pigments
LA-CO Industries/ Markal	www.laco.com	Elk Grove Village, IL	Fluorescent crayons
Organic Dyestuffs Corp.	www.organicdye.com	Providence, RI	Fluorescent pigments, dyes
Risk Reactor	www.riskreactor.com	Huntington Beach, CA	Fluorescent dyes, pigments, paints, tracers
Spectra Systems Corp.	www.spsy.com	Providence, RI	Fluorescent pigments, inks
Spectronics Corp.	www.spectroline.com	Westbury, NY	Fluorescent leak-detection dyes

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Figure 3. The UVX 300, from EMX, has a sensing range up to 350 mm, and a spot size that can be focused down to 5 mm.

possible to add fluorescent pigments, paints, or inks. Some of these substances have a color of their own, some are white, and some are completely clear under visible light and can therefore be used to put invisible markings on transparent objects. Pigments can be added to many existing materials (plastics, for example) with minimal effect on their properties, while various coatings can be applied by any number of methods—printing, brush, pen, spray, dipping, and so on.

In some cases, as in the connecting rod example, the simplest technique is to apply a mark using either contact (pens, brushes, stamps, crayons, chalk) or noncontact (spray, jet) methods. Some marking materials are permanent and others are meant to be washed off. Some are visible and others are transparent except when exposed to UV light. Figure 2 is a partial listing of sources for fluorescent materials.

Features to Look For

Commercial UV fluorescence sensors are available with effective ranges from just a few millimeters out to 350 mm, with UV spot sizes down to ~5 mm. A small spot size can be especially useful, making it possible, for example, to detect a single stitch in a sewn object or a thin line of adhesive or sealant in a joint. The ability to specify the distance at which the illuminated spot is smallest makes some range discrimination possible.

- Sensing range. In general, a longer sensing range is an advantage, not only because it makes for more versatility, but because it allows the sensor to be mounted far enough from the target area to keep it from being bumped. For example, the UVX 300 (see Figure 3) has a detection range of 350 mm.
- Spot size. A sensor that can focus the UV light down to a spot only a few millimeters wide can detect smaller targets than one that puts out an ill-focused blur.
- Color response. Not all sensors can detect all fluorescence colors; if you choose one that does not have the full spectrum, you might have to buy several to suit assorted applications.
- Speed of response. The faster the sensor can respond, the faster the production line can run.
- Easy setup. Features such as automatic teaching modes and a numerical display of the amount of detected light make it easier to set up the sensor. Since the spot of UV light (and the glowing area) may be only a few millimeters across, a confirmation of received signal strength can be a real help in getting everything properly aligned. It can be especially useful to have both self-teaching (for inexperienced operators) and manual adjustment (for fine-tuning in difficult applications).

Summary

UV luminescent sensors can solve a great many problems that would be too expensive or complicated using other methods. ■

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