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From the raw material to the final product

Glass – display – smartphone: How inspection solutions ensure quality and profitability

Have you looked at a display today? There is a good chance you'll answer this question with "yes" – after all, touch screens and displays are all around us, whether on smartphones, coffee machines, ATMs, in our cars, or at our workplaces. Technologies for ever thinner displays and vibrant display quality, outlandish shapes, and new applications open up additional market potential in consumer electronics and industrial markets. At the same time, however, they place increasingly higher requirements on functionality and optical quality. To meet these tough standards, ISRA VISION develops and produces mature inspection methods that ensure end-to-end process and quality control – from raw glass production, films, and foils, all the way to complete displays and finished products. These methods increase efficiency and profitability in the production of displays and, ultimately, boost customer satisfaction.

Touch displays enable the convenient and intuitive operation of devices and machines; plus, they are robust and easy to clean. As a result, they are also becoming increasingly widespread in production plants, medical technology, and other areas of industrial applications. The automotive industry is currently setting trends in this area with the introduction of pillar-to-pillar displays spanning the entire vehicle width in new vehicle generations. These present important cockpit functions and allow all the car's communication and infotainment systems to be operated. In addition, they are perfectly fitted and often feature curved shapes and integrated sensors. It is expected that this trend will also continue in other applications. This will require new procedures for glass processing and finishing, as well as corresponding inspection processes during manufacturing. Such quality inspection is essential to meet the stringent requirements in terms of robustness to mechanical loads, trouble-free functioning and operability, fit and optical quality.

Quality assurance begins with the raw material

Whether they employ TFT or OLED technology, modern displays consist of many layers made of different materials that are usually extremely thin. Optical films, thin-film, and thin-glass in the actual TFT or OLED display and the cover glass are joined together during the production process, achieving a perfect union of form and function. However, even the smallest defects in one of the layers can compromise the properties and function of the display. ISRA VISION is an industry leader in optical inspection and defect detection for every single layer; its solutions identify and reject defective materials before installation, minimizing the number of imperfect

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end products produced and increasing the profitability of production. ISRA VISION's SMASH is a system for inspecting the surfaces of optical films. It detects defects, including minute scratches, marks, and production residue on film materials and coatings on web materials. Line cameras guarantee a high inspection speed of up to 1,000 meters per second while also enabling the highest image resolution. At the same time, customized lighting supports the reliable detection and intelligent classification of defects that would be invisible to the naked eye. In turn, this allows conclusions to be drawn regarding causes or defective process parameters, which can be continuously monitored and optimized.

Fully automatic inspection of display glass

Thin display glasses are also subjected to a fully automatic inspection just like optical films. ISRA VISION FPM-Inspect (FLAT PANEL MASTER) combines tried-and-tested technologies for optical quality control with precise materials handling technology for use in clean rooms. This allows the system to identify even the tiniest surface, glass, or edge defects. In addition, FPM-Inspect monitors particle contamination on the substrate, thus enabling conclusions to be drawn regarding the air quality in the cleanroom. Here, too, the inspection system works with mature software algorithms to improve the production process and to detect and eliminate the causes of defects. When it comes to the 100% monitoring of evenness, rippling, and reflection optics even in large glass surfaces, ISRA VISION P² (PowerPlate) delivers precise data in a matter of seconds. Alongside defects in and on the material, this also allows the immediate detection of 3D shape defects, preventing the materials in question from being processed further.

Perfect union: Quality control before and after joining

Perfect optical films, thin films, and display glasses form the basis of high-quality displays. However, they only become a fixed unit with optical characteristics and functionality once they have been joined together during production. In this production step, quality control is just as important as inspecting the raw materials: Dimples on the cover glass and other defects can occur when adhering the layers, which cannot be recognized with the naked eye but compromise the optical properties and function of the product. SpecGAGE3D was specially developed to reliably detect local unevenness, supporting structures, or read-throughs before and after joining the display layers using deflectometry. To do so, a stripe pattern is projected onto the display and the reflection is captured by multiple cameras and subsequently evaluated. Any detected defects are then classified immediately.

Curved glasses and displays: A special challenge

Deflectometry is perfectly suited for the inspection of curved glasses and displays, for example for cover glasses of smartphones. Curved edges and concave shapes are becoming increasingly popular here and in the automotive industry since displays of the same size require

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a smaller installation width. And the shape allows information to be seen more easily on the edges. At the same time, they set even more stringent requirements in terms of quality inspection, as the fit and shape must be exactly right in addition to the perfect surface and optical quality.

The SpecGAGE3D inspection system from ISRA VISION enables the efficient and reliable shape inspection of curved and flat displays and plastic optics – such as light guides – by generating measurement data, which is superimposed with the target data of a digital twin in a CAD comparison. It thus creates a difference-map of the inspected material that is precise to the nearest micrometer. The system uses point comparison, profile sections, or full-surface evaluation to check deviations from the target geometry reliably and efficiently and then visualize them.

Bending molds are a possible source of defects in curved and flat displays. With NetGAGE3D, ISRA VISION offers precision measurement technology for this, too, by reliably identifying defects in the graphite mold. In doing so, it ensures flawless quality and thus reduces the likelihood of defects that could otherwise be reproduced in thousands of displays during production.

Reliable and precise: 100% quality control of the end product

The raw glass and foils are impeccable, no flaws occurred when adhering the parts together, and the finished display is fitted in the end product. Now it is time to perform a final check to ensure that the finished product has a perfect appearance and is free of errors. This is still often performed as a manual cosmetic inspection – with all its disadvantages, such as subjective judgment, the dependency of the inspection result on the person carrying out the test, and the general limitation of the human ability to recognize minimal quality deviations. This final inspection has a great influence on the profitability of production: When minimal defects are screened too strictly, this reduces profit, while an excessively relaxed quality inspection leads to complaints and dissatisfied customers. A fast, fully automatic, and 100% optical inspection solution solves this problem. It is easy to integrate, detects typical cosmetic defects such as scratches, bubbles, indentations, and polishing marks and delivers objective and reliable results. The SpecGAGE3D inspection system from ISRA VISION is also used during the final control and is ideally suited for the measurement and inspection of all transparent and reflective surfaces. Inspecting flat or curved displays, as well as 2D / 3D cover glass, glass back panels of smartphones, and other glossy housing parts is possible with the inspection system. This system immediately decides how to sort goods based on defined tolerance ranges and automated defect classification.

Crystal-clear quality thanks to end-to-end process monitoring

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Increasingly larger and thinner glasses, flexible materials, and complex shapes are posing ever more strict requirements for the manufacturing of displays. To meet these stringent standards and ensure the best possible quality while also achieving high productivity and process reliability, companies need end-to-end processes and quality control. It begins with the inspection of the raw materials and accompanies the entire production process right through to the end product. When defects are detected during this process, connected inspection solutions ideally allow them to be precisely linked to their cause in the upstream production steps. This also enables the effects of process parameter changes on all further processes to be tracked and monitored. ISRA VISION offers a broad portfolio of optical inspection solutions for every step of display manufacturing. Thanks to the inspection data gathered, plant operators can continuously optimize their processes and can thus achieve optimum product quality, production stability, and, ultimately, profitability. As a result, they deliver flawless materials and products – and guarantee high customer satisfaction. Moreover, the deployment of fully automatic inspection systems in production plants ensures compliance with current and future quality standards, as required, for example, in the automotive industry.

With 100% optical inspection, you are also guaranteed to meet even future requirements regarding the shape, appearance, and function of displays in production. To this end, ISRA VISION collaborates closely with leading manufacturers and customers' development departments in all key industries and can call upon a close-knit network of experts and engineers in Asia and worldwide. Whenever new materials, technologies, and applications necessitate the further development of inspection solutions, ISRA VISION is already working on their implementation in existing and new quality assurance systems alongside their development.

Images:

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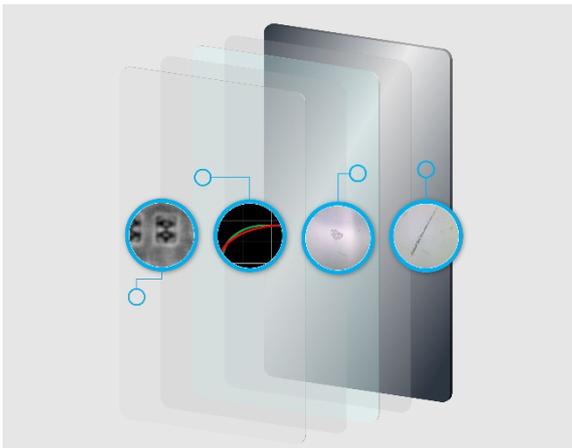
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Defect detection from the raw material to the finished display

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Deflectometric surface inspection of the end product

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ISRA VISION Flatpanel Master performing thin glass surface inspection for displays

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ISRA VISION SMASH surface inspection system for plastic film material

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