1.4.21. CHOOSING OF THE RIGHT MICROFOCUS X-RAY SOURCE AND DETECTORS

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Of all non-destructive test methods, only X-ray technology enables visual detection beneath the surface of opaque components assemblies and finished products. This has made it an essential tool in multiple manufacturing sectors, including aerospace and automotive as well as in medical imaging. A new generation of the technology centers around microfocus X-ray sources that offers much smaller spot sizes than more traditional alternatives while maintaining the necessary output power. In addition, advances in digital detection, such as CCDs, amorthous silicon and CMOS sensors have all begun to provide resolution comparable with the film.

The smallest feature that a microfocus X-ray system can detect depends on two factors: the detectors pixel and the minimum spot size of the X-ray source. Maximizing magnification requires the focal spot to be as small as possible. Important here is the type of anode. Most X-ray tubes operate by bombarding an anode with thermionic electrons, which decelerate to zero velocity and generate broadband X-ray radiation. Microfocus X-ray sources provides the solution because they incorporate focusing disc in the tube to filter the electron beam throw a small pinhole. Keeping the disk at ground potential or zero volts prevents it from generating unwanted X-rays. Such tube designs enable reflective anodes to produce 5 μm and resolve features at 100X magnification. More importantly, the microfocus X-ray source's small spot size does not effect its output power, which is important to maintain image capture rates in pace with manufacturing throughput.

From another hand, CMOS technology has enabled flat panel sensors to resolve defects that are exposed by smaller focal spot. Where necessary, pixel binning offers the option to dynamically switch between high resolution inspection and rapid large area scanning. These scanners apply different scintillator materials in one of several configurations:

– Direct deposition applies the scintillator (usually CsI) directly onto the detector's surfaseThis provides clear images but offers little protection against X-ray radiation, reducing sensor's lifetime.

– Flipped scintillator plates apply CsI onto a glass plate that is flipped over a CMOS imager The glass improves the durability but can reduce the resolution and the low energy sensitivity.

– Structured scintillators, which combine light emitted by absorbed X-ray to narrow channels, are deposited on a fiber plate. The scintillator can be CsI crystals that have a needle structure and produce a high resolution image or GdO2S which is lower in cost and resolution. In either case, these gaps deliver the converted light directly to the sensor's pixels, rendering excellent images and durable sensors. The drawback is that that these screens often entail complex, costly manufacturing methods.

The largest commercial CMOS imaging chips, measuring 18 × 22 cm, are truly advantageous in large area scan applications.

Further design innovations in both source and detectors configurations have reduce the dimentions, complexity and potential cost of these components This not only facilitates their integration into in-line, automatic inspection operations but also contribute their ease to use.