

Enabling Technology, Digital Radiography North America, 2010

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Significance of the Enabling Technology Award

Key Industry Challenges Addressed by Plasma DR Technology

One of the key factors restraining digital radiography (DR) market growth is higher product selling prices relative to those of film- and cassette-based radiography. Reducing prices while maintaining high image quality standards is necessary for penetrating new end-user segments and for driving further market growth in DR. This challenge has been especially difficult to address because of the costly and complex manufacturing processes that are necessary to produce mainstream flat panel DR detectors.

The most widely used DR flat panel detectors convert x-ray radiation into electrical image data through an indirect conversion method which requires an intermediary conversion of x-ray radiation to visible light. The conversion of x-ray radiation to visible light is performed by a layer composed of scintillating elements which luminesce when exposed to x-ray radiation. The visible light produced is then converted to electrical charge by an amorphous

silicon (aSi) based photodiode layer. A layer of thin film transistor (TFT) elements, also referred to as an active matrix array (AMA), then uses the resulting electrical charge to produce image pixel data. In addition to the technical challenges and high costs associated with manufacturing these complex detectors, the additional energy transduction required by the indirect conversion process also makes images more susceptible to blur and artifact. Worse yet, repeated exposure of the TFT layer's active electronics to ionizing x-ray radiation results in gradual damage to the detector and degradation of image quality over time.

A less popular flat panel detector replaces the scintillator and aSi layers of mainstream flat panel detectors with a single layer of amorphous selenium (aSe), a semiconductor material which enables direct conversion of x-ray radiation to electrical charge. The elimination of the scintillator layer simplifies manufacturing and improves image quality by avoiding the image blurring caused by scattering and diffusion of visible light. With these accomplishments, however, comes a new challenge related to aSe-TFT layer interfacing. Namely, charge initialization of the aSe requires the application of higher voltages, which, if not properly isolated, can damage the voltage-sensitive transistors of the TFT layer. Because of the precautions taken to avoid this issue, aSe is often inadequately charged, resulting in undesirable image latency effects and additional wait times between image exposures. Consequently, aSe based DR detectors have not been widely adopted. Also, as with AMA based detectors, TFT elements in these detectors are subject to degradation over time due to repeated radiation exposure.

With plasma DR technology, EDGE Medical Devices has successfully addressed the challenge of high costs in DR while improving the quality of obtainable images. The layers of a plasma DR detector are similar to that of the direct conversion aSe detector described with the exception of the AMA layer, which has been replaced by what is referred to as a virtual pixel array. The virtual pixel array is essentially an array of passive parallel strip electrodes, each of which is connected to a separate channel of readout electronics. The elimination of the scintillator and AMA layers used in mainstream detectors simplifies and reduces costs of manufacturing, and the removal of the voltage-sensitive elements of an AMA layer allows adequate charging of the aSe. Furthermore, the absence of active elements in the virtual pixel array ensures no detector or image degradation due to ionizing radiation. With these benefits of plasma DR technology, EDGE Medical Devices has enabled the full potential of direct conversion aSe technology to be realized at an affordable cost.

Best Practice Award Analysis for EDGE Medical Devices, Inc.

EDGE Medical Devices' Plasma DR Detector Technology

The key features of EDGE's plasma DR detectors are micro-plasma line addressing, direct conversion amorphous selenium (aSe) and low-noise readout application-specific integrated circuits (ASICs). Micro-plasma line addressing is EDGE's proprietary technology and the term used for charging a line of virtual pixels by charge injection from plasma. Prior to x-ray exposure, micro-plasma line addressing prepares the detector for image capture by sweeping across and uniformly charging the aSe to a preset electrical potential. During

exposure, the aSe absorbs and converts x-ray photons into electron-hole charge carriers, which creates a latent charge image in the aSe. After exposure, micro-plasma line addressing replenishes the charge that has been depleted by the charge carriers, inducing currents in the passive electrodes that are proportional to the intensity of incident x-rays at the location of the micro-plasma line addressing. The induced currents are then read out as image data by the ASICs.

Enables Creation of New Products

The benefits of direct conversion aSe flat panel detectors could not be fully realized until the commercialization of plasma DR technology. This technology has enabled the creation of a DR detector that provides unrivaled image quality at an affordable price. With the challenges that have been overcome by plasma DR technology, more products employing competing aSe based technologies are expected to be introduced into the market in the near future.

Enhances Current Products

EDGE's plasma DR detectors deliver both cost and performance advantages over AMA based detectors. AMA based detectors are comprised of millions of active electronic elements located on the bottom surface of the detector. Each array element must be individually addressed in order to read out the electric charge at its particular location, and failure of any of these active elements can create clusters of defective image pixels. Furthermore, because of their location on the surface of the detector, active elements in AMA based detectors are subject to repetitive exposure to ionizing radiation from the x-ray beam. Over time, radiation damages the active elements in the detector, degrading image quality. Plasma DR detectors have no active elements on the detector surface, eliminating the risk of pixel defects due to active element failure, and making the detector immune to degradation caused by radiation damage.

Manufacturing AMA based indirect conversion DR detectors is difficult and often results in poor production yields. Because of the costs and difficulties in manufacturing large area AMA detectors, some manufacturers have resorted to tiling several smaller AMA panels together in order to produce large area detectors. The resulting tiled AMA detectors require additional image processing in order to prevent seam artifacts from appearing in images. Manufacturing plasma DR based detectors is simpler because they do not require a scintillator layer and they are monolithic, avoiding the need for any tiling and eliminating the possibility of any seam artifacts.

Enables New Applications

Because of the great need for more affordable solutions in the DR market, EDGE is currently focused on meeting the needs of end-users in the DR market only. However, with the improvements in image quality that plasma DR technology brings, it can also be expected to find uses in medical imaging applications such as mammography, where achieving the best possible image quality is essential for accurate diagnoses.

Potential for Market Acceptance

The affordability and quality of EDGE's plasma DR products overcome a major barrier that has slowed widespread adoption of digital radiography for many years now. Many analog and cassette-based x-ray users who are looking for lower-cost DR solutions are likely to find great value in plasma DR detectors. EDGE is well positioned to bring their new technology to the marketplace. They have strong financial investment support from an Israeli medical device investment firm and a newly formed partnership with distributor New York Imaging Service. Their business model includes selling through VARs, integrators, and OEMs in the U.S., Canada, Europe and Asia. With distributors always looking for more affordable, high-quality, easy-to-install DR solutions, many are expected to add EDGE's plasma DR products to their portfolios. Plasma DR technology is expected to be received very well in the market, fulfilling the needs of a broad range of medical facilities which have previously been unable to afford to upgrade from film- and cassette-based x-ray.

Based on the aforementioned factors, Frost & Sullivan is proud to present the 2010 Enabling Technology Award in the North American DR Market to EDGE Medical Devices, Inc.

About EDGE Medical Devices, Inc.

EDGE Medical Devices Ltd. is a pioneering medical technology company dedicated to developing, manufacturing and commercializing innovative, high-quality digital radiography equipment at an affordable cost. EDGE is the developer and manufacturer of Plasma DR flat panel x-ray detector technology for digital radiography and the Quix™ Universal Retrofit Kit. For information about EDGE Medical Devices, visit www.EDGE-medical.com.

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