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CAN DISPLAYS DELIVER A FULL MEASURE?: MANUFACTURING

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ABSTRACT

The National Institute of Standards and Technology (NIST) recently initiated a new program on measurements for displays. As part of this new program NIST completed a preliminary assessment of the needs for measurements, standards and computations to assist in the development of high-resolution displays. In this paper, we summarize the major results of this assessment and describe briefly NIST's ongoing intramural and extramural programs on displays.

SUMMARY

High-resolution displays will be essential for the successful acceptance of advanced video systems in the market place. Advances in displays are also critical if many of the objectives of several nations for entering "the information age" are to be met. The synergism and interdependencies among a world-wide information infrastructure for a future "global village", manufacturing, and high-performance displays are great and depend on electronics and optoelectronics. For example, the high performance computers that are needed for designing complex displays will depend on successes in the manufacturing of electronic and optoelectronic components.

The display industry is attempting to improve its productivity and lower its costs. It has three main goals to (1) improve the infrastructure among suppliers, manufacturers, and users of advanced displays; (2) reduce the costs of components for advanced displays through increases in yield, quality, and reliability; and (3) increase the number of functions performed by displays.

To assure that the display industry can accomplish the above goals and be successful in the development of advanced display systems and to assure that people use displays intelligently, greatly improved measurement capabilities are needed. Specifically, new measurement capabilities are needed to support: (1) research and development of new advanced displays for diverse applications; (2) design of display components and control of quality during manufacturing processes for display components; (3) technical evaluation of displays and components; and (4) common specifications for acceptance of display products.

NIST has conducted an assessment of technical challenges and measurement needs for producing advanced displays. The details and conclusions from that assessment are given in NISTIR 4583,[2] in which we summarize the high and medium technical priorities for manufacturing active matrix liquid crystal, plasma, and electroluminescent displays. These priorities represent major technical challenges and give rise to a number of measurement and standards challenges. For example, in order to reduce process-induced defects, real-time and contactless process monitoring is needed. Such monitoring enables control of the manufacturing process by providing rapid feedback when defects are detected and when deviations from process and design specifications are observed. Manufacturers will use computers to monitor, to simulate, and to control each process step. Monitoring demands real-time sensing of process status for fast feedback control of the gas-phase and gas-solid-phase reactors used in many flat-panel display processing steps. Real-time means that the measurements and controls are completed in a time that is less

than the time it takes for the process parameter being monitored to change. Simulating processes requires sophisticated computer programs to predict the deposition, doping, and patterning. Controlling processes requires the design of computer-controlled actuators and reactor valves. Chemical-vapor-deposition methods are dominant in fabricating flat-panel displays. The success of real-time control depends in part upon very fast measurement methods, most of which are not presently available. Other examples include packaging, interconnects, inspection, phosphors, and drivers and integrated circuits.

Concurrent with the above assessment, NIST initiated new programs to address a subset of those measurement needs given in its assessment; namely, measurements to assess display performance and to interface displays with computers. NIST's approach is to choose, when possible, projects that are generic to more than one display technology and for which NIST has existing resources or is likely to have resources. NIST has developed a program of measurement technology for advanced imaging systems. One component of the program is the creation of a laboratory to provide measurements of flat-panel display performance. In order to qualify a display's suitability for a given task both the manufacturer and the user need a common specification language regarding display performance characteristics. Since NIST is neutral regarding manufacturer preference, it is in an appropriate position to provide assistance to the development of standards and measurement practices which do not favor any single display technology.

In addition to the intramural programs on displays, NIST's Advanced Technology Program (ATP), an extramural NIST program, funds precompetitive and generic research in many technologies. The ATP has made several awards that are related directly or indirectly to display technologies. ATP Awards that relate directly to display technologies include: 1) American Display Consortium - develop automated inspection and repair technology, interconnections, packaging, and patterning technology; 2) American Scaled-Electronics Consortium - develop multi-film module technology and fabricate flat panel displays with on-board drivers and logic on a glass substrate; 3) FED Corp. - field emitter display development; and 4) Hercules, Inc. - optically controlled alignment materials. ATP Awards that relate indirectly to display technologies include: 1) Spire - real-time feedback control of metalorganic chemical vapor deposition reactors; 2) Cree Research - advance SiC crystal growth, epitaxial deposition, and doping processes for power electronics and blue light emitting diodes; 3) Spectra Diode Laboratories and Xerox - fabricate monolithic arrays of laser diodes that emit infrared, red, green and blue light for several applications, one of which is compact color projection displays; 4) Thomas Electronics, Inc. - flat fluorescent light sources; and Philips Laboratories - microminiature light source technology.

CONCLUSION

A necessary but not sufficient condition for displays to deliver a full measure will be internationally accepted measurement techniques for manufacturing and for characterizing displays and consistent sets of interoperable, extensible, and compatible standards and protocols appropriate for many applications throughout the "global village."

ENDNOTES

1. A contribution of the National Institute of Standards and Technology, not subject to copyright.

2. *Measurements for Competitiveness in Electronics, Chapter 11 Video*, National Institute of Standards and Technology Internal Report Number 4583, First Edition, April 1993, pages 339-378. This Chapter 11 contains a more complete assessment of the technical challenges and measurement needs faced by the display industry than contained in this summary. Readers may obtain copies of NISTIR 4583 by sending a FAX to H.S. Bennett at 301-975-4091.