CMOS APS Responsivity Variation Measurement and Analysis by means of our Unique Sub-micron Scanning System

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ABSTRACT

This work demonstrates the measurements performed via our unique Sub-micron Scanning System (S-cube).
The system enables the combination of near-field optical and atomic force microscopy measurements with the standard electronic analysis. The system obtains an optical signal as input and returns an electrical signal as output. It is capable to hit onto a desirable well-defined point within the scan area. It is able to focus the incoming light signal into the spot of the desirable diameter size (e.g., d<0.5 micron or d<0.35 micron according to the standard VLSI technologies) after penetration through the certain transparent oxide depth without beam broadening, i.e., the desirable size of spot is maintained during the scan. The obtained signal, i.e., the electrical outcome at each point as a function of the spot position provides a 2D signal map of the pixel response, representing the full 3D charge distribution in the device.
This work present the results obtained by thorough scanning of several various pixel topologies of CMOS Active Pixel Sensor (APS) chips fabricated in two different CMOS technologies (the standard 0.5µm and 0.35µm CMOS technologies).
We demonstrate that our system use enables a detailed, point by point, quantitative determination of the contributions to the total output signal from each particular region of the pixel. It makes possible to understand the influence of the each component composing the pixel (e.g., logic transistors, metal lines, etc.) which is extremely important for CMOS APS since the pixel structural construction defines a fill factor of less then 100%. We also show the use of our S-cube system for full point spread function (PSF) [1, 2] and crosstalk (CTK) [3] measurements of focal plane CMOS APS arrays. This is unique to our system. Other systems provide Modulation Transfer Function (MTF) measurements, and cannot acquire the true PSF, therefore limiting the evaluation of the sensor and its performance grading. A full PSF is required for better knowledge of the sensor and its specific faults, and for research – to enable better optimization of pixel design and imager performance.
We present the results which indicate that the PSF use for the CTK measurements enables not only its magnitude determination, but also track of its main causes and show that for any potential pixel active area shape a reliable estimate of the CTK in the imager is possible, enabling the design optimization per each potential pixel application.

REFERENCES

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