A Fast, High Resolution Imager for Nanosecond Light Pulse Detections

F. Morel, J-P. Le Normand, V. Zint*, W. Uhring*, Y. Hu and D. Mathiot*

Laboratoire d’Electronique et de Physique des Systèmes Instrumentaux (LEPSI)
IN2P3/ULP, 23, rue du Lœss, 67037 Strasbourg Cedex, France

* Laboratoire Physique et Applications des Semi-conducteurs (PHASE)
23, rue du Lœss, 67037 Strasbourg Cedex, France

Abstract: Monolithic pixel sensors made in a CMOS technology, are used nowadays as an very important alternative to CCDs for many applications in visible light imaging [1]. Today, the implementation of active pixel structure (APS) has great importance because the CMOS image sensors can integrate the photon detection technology, readout electronics, digital control systems, image enhancement and intelligent signal processing in a single chip. Another important feature of the APS is the possibility of controlling different integration time per pixel in different regions of array. This property can be utilised to design an imager with high temporal resolution in order to replace the streak cameras [2] for many applications in biomedical domain. It produces the intensity information as function of one spatial dimension and time (I = f(x, t)) from a two spatial dimension frame. In order to validate this idea, the first prototype FAMOSI (FAst MOS Imager 1) [3] with single shot has been realised. In this paper, a new design FAMOSI_2 is presented. The chip FAMOSI_2 is composed of a 64 x 64 pixel array. The columns represent the temporal dimension by different start time of integration, and the rows the spatial one. The pixel developed for FAMOSI_2 has a new architecture with a photodiode allowing to implement an electrical shuttering and an analogue accumulation in the pixel in order to increase the system resolution. The electrical shuttering permits of having the same integration time for each column but with a different start time. The analogue accumulation is useful with repetitive light phenomena for increasing the system sensibility. The prototype FAMOSII is realised in 0.35 CMOS AMS technology. A 30 nanosecond light phenomenon with a repetitive rate of 3 microseconds can be observed by the chip. In this paper, the chip’s functionality, the simulation and measurement results will be presented.

References:

