C-3-5LN

A4-16 bits/mm Contact Type High Speed Image Sensor Using an a-Si:H Photodetector Array

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Recently, several kinds of contact type image sensors have been developed, because their short focal length can reduce the physical dimension of facsimiles or copiers.
Among photon-electron conversion materials, amorphous silicon is becoming popular, because of its better temperature stability and its quicker photoresponse characteristics compared with amorphous chalcogenide films.

However, it is difficult to read out the signals generated in an amorphous silicon film at high speed, because if the read-out method is of the storage mode, stored photocharge decreases in proportion to the storage time when the light intensity is constant, and then the stored signal charge quantity becomes comparable to that of the switching noise charge which is generated by MOS FET's gate voltage swing across it's gate-source and gate-drain stray capacitance.
Therefore reduction of switching noise will make it possible to read out signal more quickly, whereas dark current doesn't play an important role because it's stored charge decreases in proportion to the storage time.

A new 128-bit low noise multiplexer LSI has been developed to minimize the switching noise.
It is proved that with this LSI, light-shielded amorphous silicon sensor structure and highly-integrated low noise hybrid circuits technology, an A4-16 bits/mm image sensor can read an A4 size document within 0.8ms/line.
This corresponds to a 0.2ms line scan time for an A4-8 bits/mm image sensor. This shows that more than ten times in speed and four times progress in area resolusion have been achieved, compared with previous contact type line sensors.
This speed is estimated from the measured data on experimental samples (16 bits/mm on 2"x3" substrate).
The results obtained from the evaluation of the A4-16 bits/mm sensor will be reported at the conference.

The top view of the A4 sensor is shown in Fig.1 and that of the experimental sample is shown in Fig.2.
Photosensitive area is formed along the center of a glass substrate (240x50x1.2mm).
Half of the total twenty eight LSIs are populated on each divided area by the photosensitive array(3456 bits).
Conductive patterns from photosensitive spots to the LSIs are designed to be electromagnetically isolated from the LSIs' driving pulses to minimize crosstalk noise.
The photosensitive area is made of 200nm-thick Cr electrodes, 1000nm-thick a-Si:H photoconversion layer, 75 nm-thick ITO trans-parent electrode layer, and 200nm-thick Cr light-shield layer.

The fabrication procedures are as follows. First, a Cr metal layer is evaporated all over the glass surface. The Cr layer behaves as a hole barrier metal to the amorphous silicon and as an adhesive for the gold conductive line and bonding pad to the glass.
Next, amorphous silicon is deposited,and ITO is deposited on it to construct Shottocky barrier photodiode cells.
Then ,a Cr conductive layer is formed to enhance long and narrow ITO's conductance and to shadow the place where the photosensitivity is not required .
LSIs are mounted on the substrate and electrically connected to the conducting pattern by wire bonding. The cross sectional view is shown in Fig.3.

The new LSI basically consists of 128 channel pre-amplifiers , C-MOS analog switches and shift registers.
The gate size of both N and P type MOS-FET are designed to have the same dimension which is minimized until the on-resistance value significantly influences it's read-out time constant.
And so,the switching noise is minimized.
Output signal at 100 lx and dark signal are shown in Fig.4.
The result shows that one line scan can be made within 0.8ms for A4-16 bits/mm image sensor with 20dB S/N ratio , without any additional noise cancelling circuits.

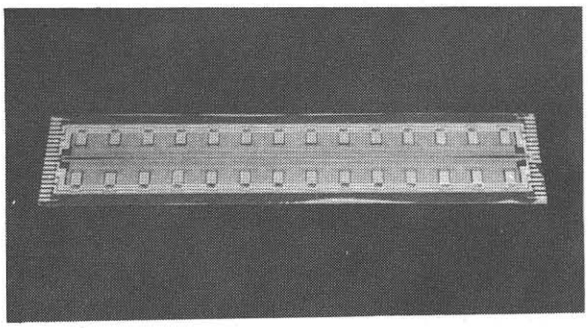

Fig.1 The top view of the A4 sensor.

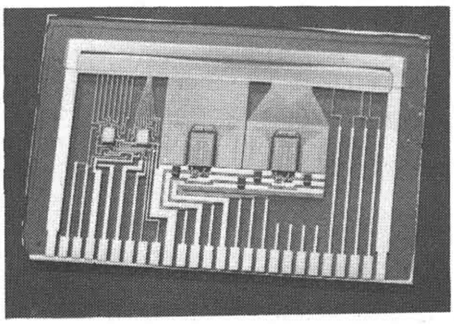

Fig.2 The top view of the experimental sample.

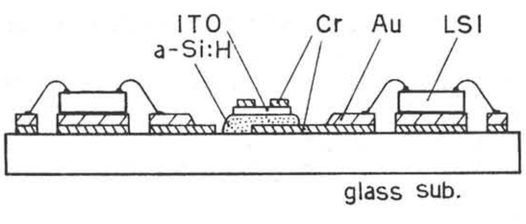

Fig.3 The cross sectional view of the A4 sensor.

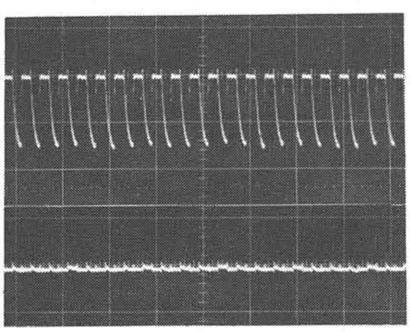

Fig.4 Output signal at 100 lx and dark signal.
Vertical: 0.5V/div.
Horizontal: 2µs/div.