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B—3—3 A Contact Type Linear Photosensor Array Using An Amorphous Thin Film

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Recently, along with the decrease in size of facsimile equipment, requests have been made for a contact type linear imaging sensor which does not require a lens system. The most important condition for realizing such an imaging sensor is that it ~~be~~ is possible to easily produce a sensor approximately 210 mm in length. It is considered difficult to realize such a device using conventional silicon imaging sensors, because their length is limited to about 30 mm at most.

On the other hand, it is well known that a thin film of Se-As-Te chalcogenide glass is used as the target of "Saticon", a T.V. pickup tube. In the following this film is called Saticon film. The attractive features of Saticon films are as follows: (1) They can be fabricated by vacuum-deposition, and so applied to larger imaging devices. (2) They are semi-insulating films, and hence it is not necessary to isolate each photosensor when applying them to a linear imaging sensor. (3) They have excellent photoelectric properties, especially sensitivity to visible light. (4) They are stable in the air, thus it is not necessary to surface-passivate. These features indicate that Saticon films are suitable for applications as linear imaging sensors with long size. In this work, Saticon films are applied to a contact type imaging sensor and its characteristics are evaluated.

A schematic cross-section of the fabricated device is shown in Figure 1. The fabricated device is a linear photosensor array, which consists of 40 photosensors, each of which is 250 x 200μm, and its overall length is 10mm.

The fabrication procedures are as follows: The substrate used in this device is made by obliquely cutting the end of a fiber plate (Fig. 1), where the diameter of each fiber is 25μm. Next an SnO_2 transparent film, 150 nm thick, and then a 100 nm thick chromium film are formed on the substrate. Then, a chemical-etching process for the chromium film and an ion-beam-etching technique for the SnO_2 film are employed to form the stripe electrodes shown in Figure 1. At this time, the chromium portion of the tip is removed to provide a window for the passage of light. Consequently, only the light scattered near point A of the actual picture, as shown in Figure 1, incidents into the photosensor. A 2 μm thick Saticon film is then vacuum-deposited on these stripe electrodes. Finally, gold is vacuum-deposited as the common electrode.

The photosensors obtained by this process are basically hetero-junction photodiodes with a sandwich structure of SnO_2 (N)-chalcogenide glass (P)-Au. The I-V characteristics of each photosensor in the dark and under illumination are shown in Figure 2 where the photosensors are reverse-biased. From this figure, it is noted that the photocurrent tends to become saturated at voltages higher than 10 V. The operation voltage is selected in the saturated range, in this case, 25 V. The voltage can be controlled over the range from 5 to 50 V by changing the thickness of the Saticon film from 0.4 to 4 μm. These photosensors are sensitive to visible light and the most sensitive wave length is about 450 nm. This wave length can also be controlled by changing the composition of the Saticon film. The photo response time was less than 1 ms. A picture is taken using the fabricated imaging sensor under following conditions: operating voltage of 25 V and charge storage time of 10 ms; and is shown in Figure 3. The light source in this test case was specially prepared and consisted of 10 LED's.

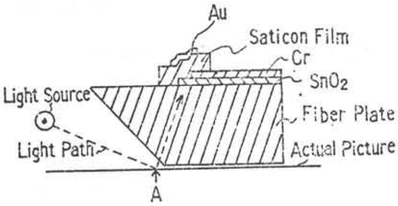

Fig.1 Schematic cross section of the fabricated device

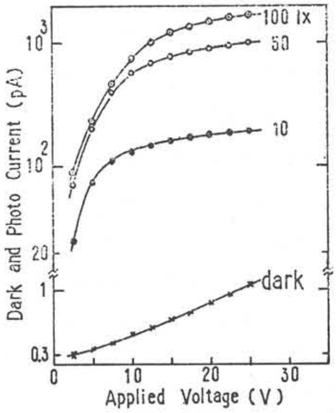

Fig.2 I-V characteristics of the photosensors in the dark and under illumination

In conclusion, it has been confirmed that Saticon films are applicable to contact type linear photosensor arrays and other imaging devices. They enable production of large-size sensor arrays and imaging equipments with small overall size, a definite advantage over conventional sensors.

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Fig.3 Picture taken using the fabricated imaging device

Reference

1) Eiichi Maruyama,et al: Proc. 6th CSSD Tokyo (1974)