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Amorphous Semiconductor Photovoltaic Devices with Integrated Memory Functions

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Reversible photosensitive materials such as the electrooptical crystals[1] and the amorphous semiconductors[2] are undoubtedly very important in wide fields of the optical information processing. Electrooptical crystals are well-known for their remarkable optical characteristic change caused reversibly by electrical and optical means, but their electrical characteristic changes are, in most cases, not sufficient to be usable in the ordinary photo-detection.

Amorphous semiconductors, on the other hand, can be utilized as photo-detecting materials[3], of larger size and lower cost as well as information storing capability may be expected for them. We report here the detection of light intensity variation in time and space using the photovoltaic effect of an amorphous semiconductor device with the memory function.

In our experiments, an As-Te-Ge amorphous film with the deposited Mo electrodes exhibited a photovoltaic effect, which has a fast time response to the He-Ne laser light pulse (wavelength 0.633μm) and depends on the light illuminating position relative to the electrodes.

The relation between the induced photo-voltage V and the laser beam location is illustrated in Fig. 1. The polarity of the induced voltage depends upon the direction of the incidence. The induced voltage on the illuminating electrode is negative. And the region which shows the induced voltage is localized at the beam spot. The response of the induced photo-voltage is considerably fast. The response of the system is shown in Fig.2. The first line shows the wave form of the incident laser beam chopped by the mechanical chopper, which is monitored by the photodiode. The fifth line is the wave form of the induced voltage when the laser beam illuminates the center of the electrode.

This effect is very much promising for the optoelectronic devices, for example , matrix form photo-detector, imaging devices,and both sides appreciable photo-detector.

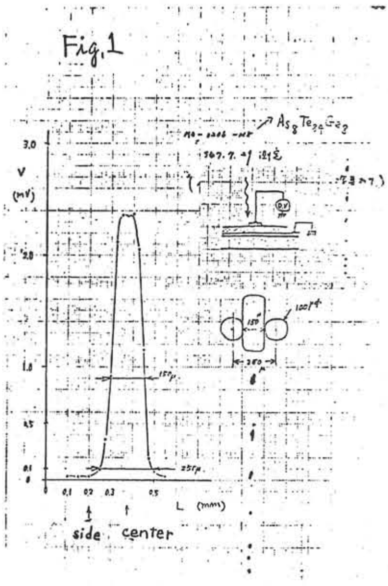

Fig. 1. Induced photo-voltage and the place of the laser beam spot relative to the electrode. The induced voltage is negative on the illuminating electrode.

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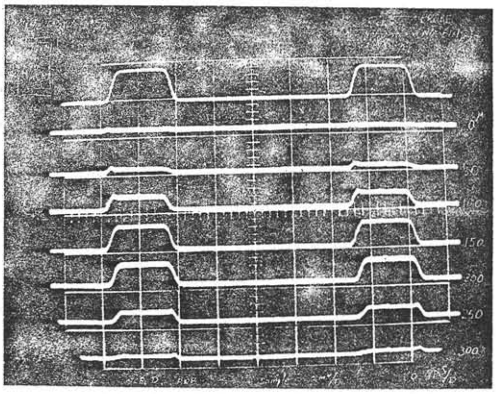

Fig.2. Time responses of the induced photo-voltage at the different points of the beam spot. The first line shows the wave form of the incident laser wave which is monitered by the photo diode. The values written on the right side show the distance between the beam spot and the spot which is 150μm far from the center of the electrode.