7-5 Field Enhanced Processes in Photodoping Effects in Amorphous As_2S_3

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Recently photodoping effects, i.e., diffusion of some metals into chalcogenide glasses caused by light, has been reported [1,2]. However, experimental results reported so far are still not sufficient for theoretical understanding of the mechanism underlying these phenomena. Especially, the mechanism of the triggering action of the light in photodoping process and the effect of local field at metal-chalcogenide glass interface have not yet been touched upon.

This report shows some experimental data to contribute for clarifying the mechanism of photodoping effects.

Specimens were prepared by conventional deposition of Ag and As_2S_3 on SnO_2 glasses, sequentially. Schematic representation of the specimen is shown in Fig.1. The width and thickness of Ag strip are 50-200 μm and 0.7-1.0 μm, respectively. The thickness of As_2S_3 film is 0.5-1.0 μm.

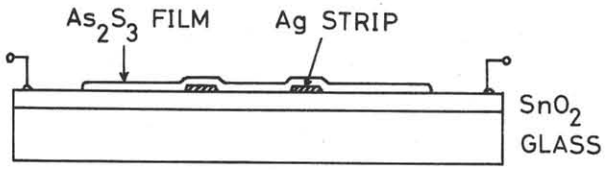

Fig.1

PHOTODOPING VERSUS THERMAL DOPING

When white light is irradiated on the specimen, photodoping occurs in the transverse direction as shown in Fig.2(a) schematically. On the other hand, when the specimen is heated in the dark, thermal-doping occurs as shown in Fig.2 (b). Clear difference is not observed between photodoped and thermally-doped specimens under a microscope. By electron microprobe X-ray analyses, however, clear differences are observed in EMX profiles between these two specimens as shown in Fig.3.

MATERIALS PRODUCED BY PHOTODOPING

It is shown by X-ray diffractometer that As_2S_2 and Ag_2S crystals are produced only in the case of photodoping.

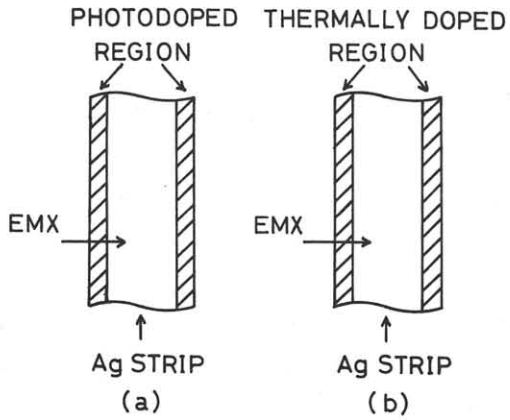

Fig.2

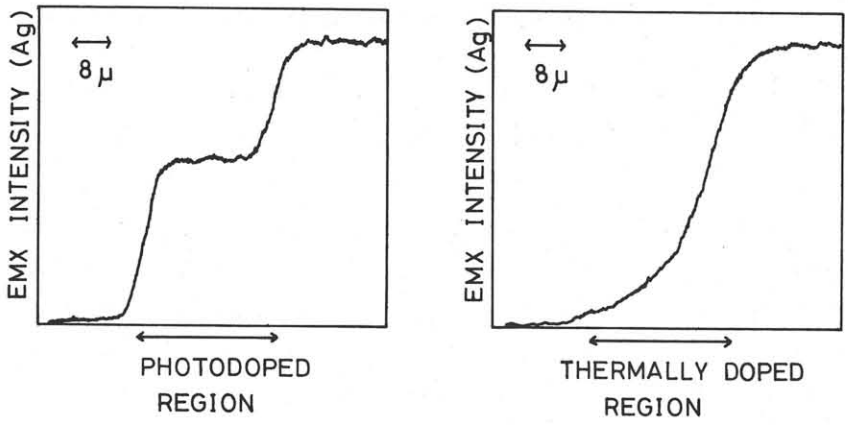

Fig.3

ELECTRIC FIELD ENHANCED PROCESSES

When a proper current flows in SnO_2 (Fig.1), electric field leaks into the As_2S_3 film. If the electric field pulses are applied on the specimen in this way during the irradiation, photodoping is drastically enhanced by this electric field as shown in Fig.4. The enhancement is observed on the negative electrode side of the Ag strip.

OTHER EXPERIMENTS

Photovoltage in the system Ag-As_2S_3-SnO_2 (Pt) was also observed. Most recently, formation of a latent image by electric field has been investigated which might give us new capability in imaging technology.

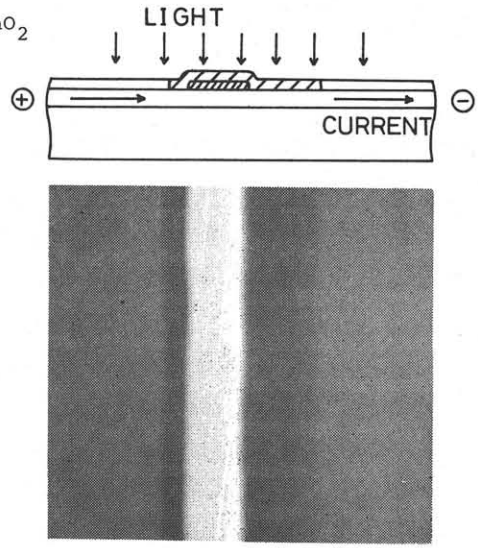

Fig.4

References

(1) H.Sakuma et al: Proceeding of the 3rd Conference on Solid State Devices, Tokyo, 1971

(2) M.T.Kostyshin et al: Soviet Phys. Solid State, 8 (1966) 451

(3) e.g. K.Tanaka: unpublished data and private communication.