The 6th Conf. on Solid State Devices, Tokyo, Sep. 1974 Digest of Tech. Papers A5-3 Active Light Deflector by Use of Amplified SAW in CdS

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Introduction For realization of acousto-optic devices such as light deflectors, modulators and filters, it is often necessary to excite high frequency acoustic surface-waves (SAW). But in order to excite high frequency acoustic waves, highlydeveloped technologies for fabricating transducers having super-fine structure are needed. Moreover, acoustic propagation loss increases with the increase of frequency. One convenient way to overcome such difficulties is to add an active action to the devices. That is, amplification of acoustic waves should be considered. It is known that in the case of the amplification of acoustic waves in piezoelectric semiconductor, possible maximum gain per unit propagation length increases with frequency.<sup>2)</sup> This characteristic is attractive for our purpose. In this paper we propose a new active light deflector by use of amplified SAW in CdS, and present preliminary experimental results. .

Structure of Deflector We have already reported the prism-shaped structure 3)

useful for constructing the optical system on high refractive index substrates. In this experiment, an improved structure to excite light in the optical guide is adopted, as shown in Fig.1. A photoconductive CdS single crystal is cut as in this figure. Optical waveguide is made by sputtering Corning 7059 glass on Ag-film-coated CdS. The thickness of glass film and Ag film are about 2µm and 1000 Å respectively. In order to excite Rayleigh waves of 64 MHz, the third multiple of the fundamental frequency of the transducer, and to monitor the amplified signals,

two transducers having 80 µm finger period, 12 finger pairs and 0.8 mm aperture are vacuum-deposited on the basal plane of CdS. He-Ne Laser (A =6328Å) light beam is led to optical waveguide from the substrate side, and is taken out in parallel direction with incident beam.

Experiments and Results Fig.2



Fig.2 Experimental setup

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Photomul

schematically shows the experimental setup. Drift pulses are applied between two transducers, and the propagation plane between them is illuminated to excite carrier. The light for illuminating the sample is brought through optical fiber after adjusting the intensity and the wavelength to supply the appropriate carrier concentration for surface wave amplification. Fig.3 shows the amplification characteristic of this sample. About 30 dB amplification was obtained between two transducers at the saturated region of the amplification. Fig.4 shows waveforms observed in this deflection experiment. In the photograph, the trace(a) is the output of photomultiplier and the trace (b) the output of the receiving transducer. The applied drift voltage dependency of deflection light intensity when the RF input power constant is shown in Fig.5. As shown in Fig.5, the light deflection efficiency has such tendency as the efficiency becomes higher with the increase of the applied voltage, though the absolute value of the efficiency is considerably low.

<u>Conclusion</u> An active light deflector having a simple and stable structure is proposed, and potentiality of this device is demonstrated. It can be said that the active interaction should be considered to make acousto-optic



References

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Fig.3 Amplification characteristic



Fig.4 Observed waveforms





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