5-1 Non Volatile Optical Pattern Memory using MAOS Structure

Yasuo Tarui, Yoshio Komiya and Tsunenori Sakamoto
Electrotechnical Laboratory
Tanashi, Tokyo

Recent pattern recognition technique is requiring the development of optical input pattern memories which memorize the light intensity as analogue values. The purpose of the paper is to search the feasibility of the analogue memory using MAOS structure.

The condition of the deposition of Al_2O_3 are; wafer temp. 850 °C, Al_2O_3 temp. 150 °C, CO_2 flow rate 50 cc/min., H_2 flow rate 2 l/min., the growth rate 450 Å/min.. 1 KW Xe. lamp is used as the ultra violet light source. The metal electrode of MAOS structure is thin gold(200 Å) evaporated film.

Preliminary experiment is done by shining U.V. light on the MAOS diode Structure and measuring the change of the V_{FB} as the function of time during P.B. (photo bias) treatment.(1) Fig.1 shows an example of the change of the V_{FB} when P.B. treatment with bias of +50 volts applied after P.B. treatment at zero volt for enough time to saturation, and the reverse process. Fig.2 is same kind of change for the bias between zero and -50 volts. The same sample shows negligible change of V_{FB} when bias is applied without shining U.V. light. There is also negligible change with P.B. treatment in the case of MOS structure. Fig.3 shows the discharge current measured at the transient from V_{PB} = +40V to V_{PB} = 0V.

Fig.4 shows the band diagram of the MAOS structure at the beginning of each trasient in Fig.1 and 2. The major current component is shown within a circle as I, determined from the consideration of Fig.1,2 and 3. For example, in Fig.4(a), I_1 and I_3 are the current component in accordance with the direction of the V_{FB} change. Among I_1 and I_3, the major current I_1 is determined by the definite threshold energy of 3.6 eV obtained from Sat.$V_{FB} \sim h\nu_{max.}$ curve redrawn from Fig.1. The definiteness of the threshold energy eliminates the possibility of the major current to be the current from hole traps I_3. The major current component I_4 or I_5 in Fig.4b is determined from the current direction in Fig.3, but this major current component depends on the photon energy and thickness of SiO_2 and Al_2O_3.

A optical pattern input electrical readout memory is constructed using MAOS transistor matrix structure as shown in Fig.5. Fig.6 shows the photograph of a part of the optical pattern memory. Fig.7 is the charactristics of MAOS transistor elements of the memory matrix with three different V_{PB} voltage. The physical parameters of the p channel MAOS transistor matrix are as follows; substrate; n 10 Ωcm(111), the channel length; 14 μ, the channel width; 380 μ, the number of gates and drains; 10. Fig.8 shows the output pulse train obtained by writing with variable light quantity and reading with the circuit in Fig.5; this shows the possibility of optical pattern input analogue memory.

We are grateful to H. Teshima, T. Fujishiro and K.Sugiyama for their cooperation.

(1) Y. Komiya, Y. Tarui, T. Fujishiro: Fall Convention Record of Japan Soc. of Appl. Phys., P.181,1971.

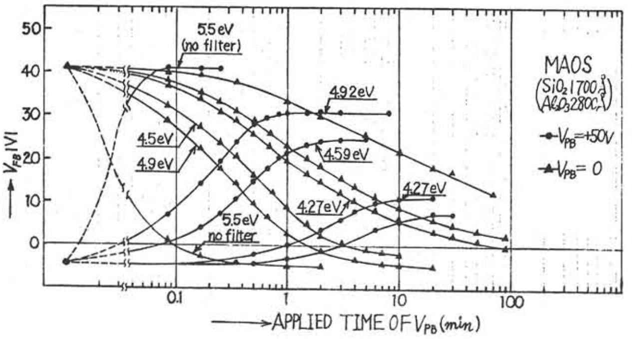

Fig 1. CHANGE OF V_{FB} IN PLUS BIAS REGION OF V_{PB}

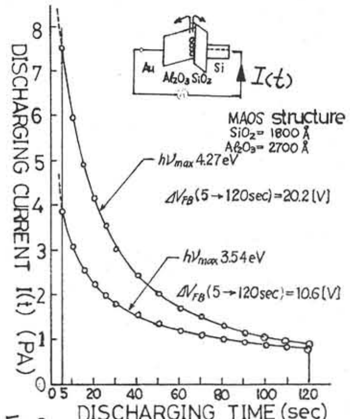

Fig.3

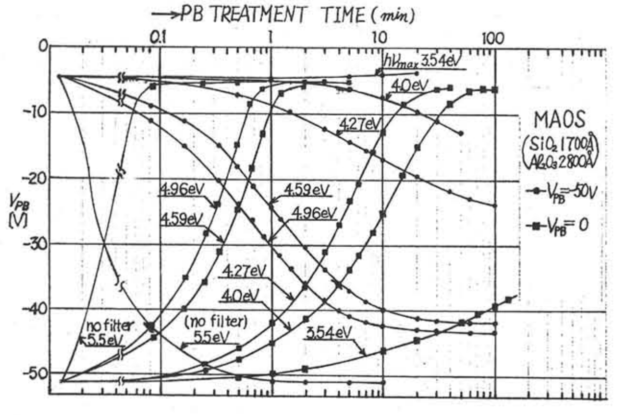

Fig 2. CHANGE OF V_{FB} IN MINUS BIAS REGION OF V_{PB}

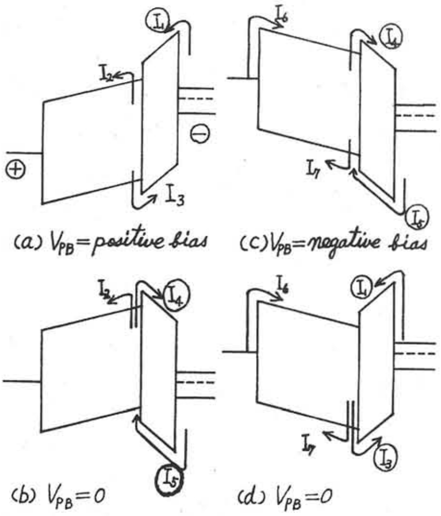

Fig.4 BAND DIAGRAM AND CURRENT
(a)(b) CORRESPOND TO Fig 1 (c)(d) CORRESPOND TO Fig 2

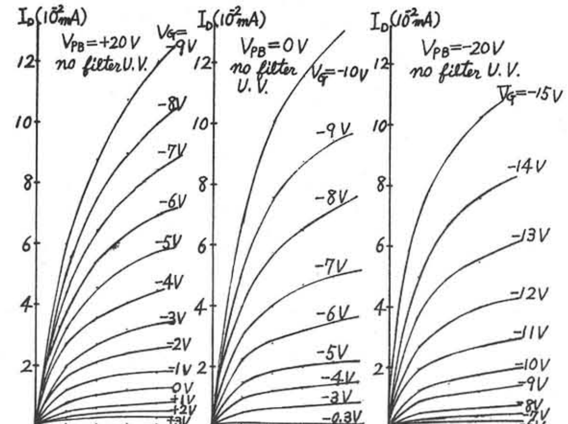

Fig.7

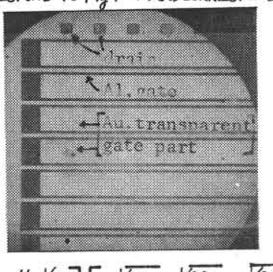

Fig.6

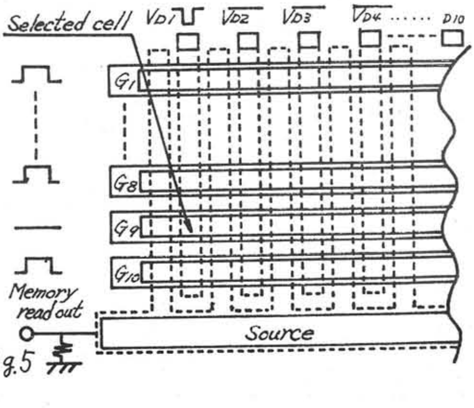

Fig.5

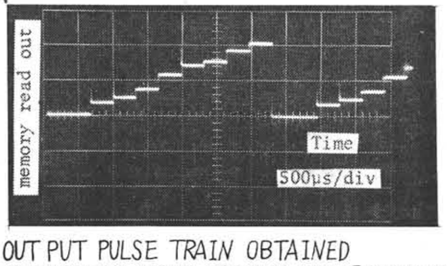

Fig.8 OUT PUT PULSE TRAIN OBTAINED BY WRITING WITH VARIOUS LIGHT QUANTITY