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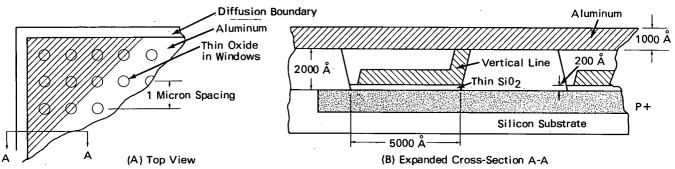
NASA TECH BRIEF Goddard Space Flight Center

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Nonvolatile Read/Write Memory Element: A Concept

A nonvolatile read/write memory with a limited number of programming cycles may be achieved through the use of verticle, fusible links in series with oxide-breakthrough elements. The memory of the oxide windows. An extremely thin aluminum layer is needed in order to obtain the high current density required for fusing at low input-power levels.



elements can be fabricated with integrated circuit technology and are ideal for low-power digital computer applications.

A cross-section view of a representative element (see fig.) shows the fusable link, which consists of a thin aluminum film evaporated on a silicon dioxide layer, and the oxide breakthrough element. Initially, the memory element is an open circuit. If a high voltage pulse is applied, the oxide breakthrough element changes into a conductive path and the element appears to have low resistance. A subsequent high current pulse will open the fusible link, and the memory element again appears to have a high resistance. The high and low resistance values determine the appropriate logic state.

The fabrication process consists of etching small windows, one to five micrometers in diam., in a thick oxide. An oxide approximately 200 Å is grown or deposited for the breakthrough device. A thin aluminum layer is then deposited over all

In operation, each memory element is programmed be either an open circuit (OC) or a short circuit

to be either an open circuit (OC) or a short circuit (SC). The initial OC state is achieved by opening the fuse with a large current; the SC state is achieved by breaking down the oxide with a large voltage. These operations limit the number of times that the memory can be programmed. However, since the element density exceeds 2×10^6 elements per cm², a sufficient number of elements are available for reprogramming; e.g., in a 256 bit memory array occupying an area of 100×100 mils, nearly 100 memory element pairs per bit can be obtained. This means that the memory could be reprogrammed 100 times. If a larger number of bits is required, such as 1024 bits, then the memory could be programmed more than 25 times.

Notes:

1. Related work on low current fusible links and oxide breakthrough structures is reported in

(continued overleaf)

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2. Requests for further information may be directed to:

Technology Utilization Officer Goddard Space Flight Center Greenbelt, Maryland 20771 Reference: B71-10346

Patent status:

No patent action is contemplated by NASA.

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Source: J. R. Cricchi and W. J. Lytle of Westinghouse Electric Corp. under contract to Goddard Space Flight Center (GSC-10993)