Digest of Tech. Papers The 7th Conf. on Solid State Devices, Tokyo, Sep. 1975

E-1-2 PROBLEMS ON HIGH SPEED BUBBLE DEVICES

Takashi FURUOYA

Central Research Laboratories, Nippon Electric Co., Ltd.

1753 Shimonumabe Kawasaki

Main bubble domain application is a high speed solid state file memory. The access time falls into the so-called memory hierarchy access gap. However, there are many problems to be solved.

Assuming major-minor loop organization, bubble memory latency time is given by $M^{1/2}f^{-1}$, approximately, where M is total capacity of a major-minor loop and f is the rotating field frequency. In the major-minor loop having 10^4 bit, operating frequency is 1 MH_z for 0.1 m sec latency time. Therefore, it is necessary to develop the bubble device operate at up to 1 MH_z, at least.

In the bubble materials, operating speed depends on saturation velocity (V_p) of bubble as well as wall mobility. V_p is given by $24\gamma A h^{-1}K_u^{-1/2}$, where $\gamma = g e (mc)^{-1}$ is gyromagnetic ratio, A is exchange constant, h is film thickness and K_u is uniaxial anisotropy constant. Thus, far atempts to maximize V_p have involved keeping h and K_u as small as possible. Recently, a garnet film having a g-factor greater than 30 has been developed. It can operate at 1∿2 MH_z over 10^6 steps with no deterioration in bias margin. However, there are many problems consistent with other requirement.

The rotating field coil power dissipation is proportional to the operating frequency, volume in which driving field is applied and square of rotating field amplitude. Therefore, it is very important to develop materials having high bit density as well as high saturation velocity, high packing chip technology and bubble circuits operate in a low rotating field.

In addition to high speed bubble materials and devices, development of a memory organization which improves the memory access time is very important. Dynamic data re-allocation and reversal of rotating field direction are proposed to significantly improve access time.

An estimation will be made of the practical limitation of the bubble memory operating speed considering these problems.