PROBLEMS ON HIGH SPEED BUBBLE DEVICES

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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 $N^{1/2}f^{-1}$, approximately, where $N$ 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 $1 \text{ MHz}$ for 0.1 m sec latency time. Therefore, it is necessary to develop the bubble device operate at up to $1 \text{ MHz}$, 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 attempts 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 $1\times2 \text{ MHz}$ 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.